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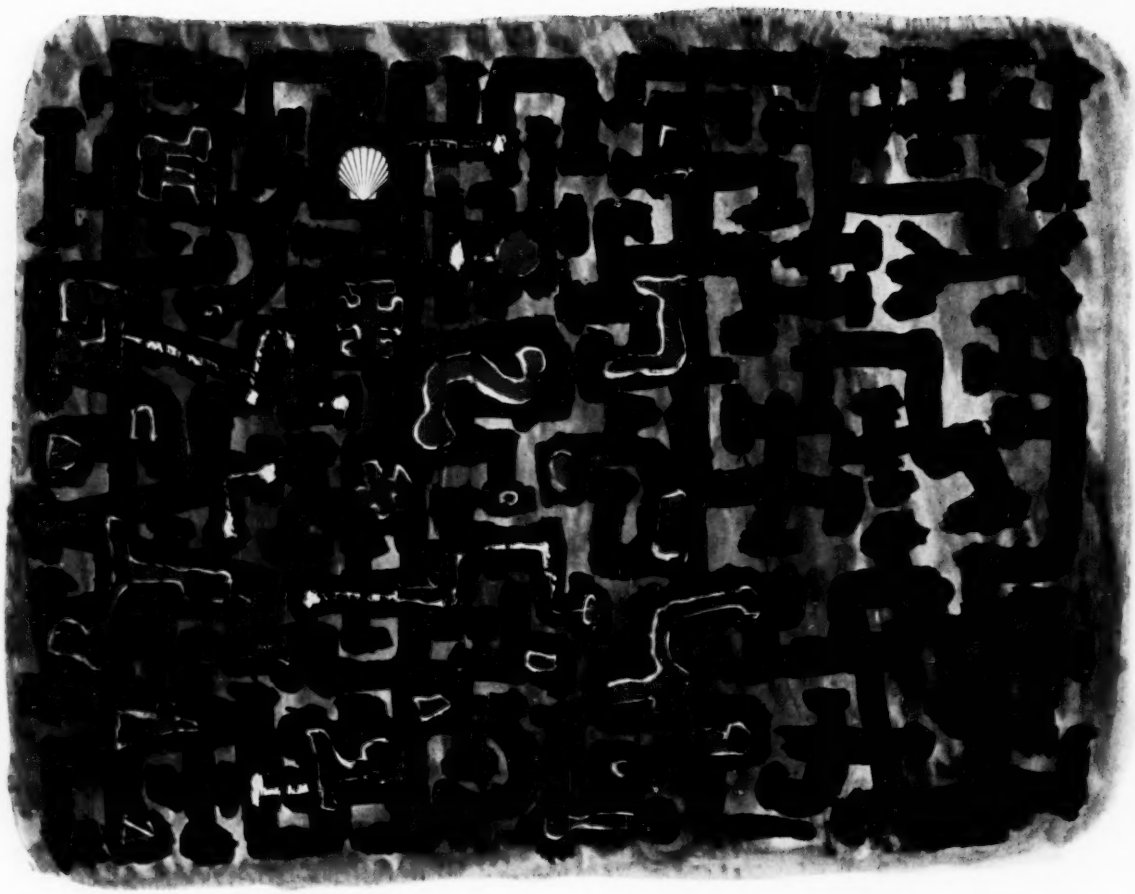
Chemical Engineering

A McGRAW-HILL PUBLICATION

Nonmetallic, inorganic



- Why they offer better processing
- Where they will help most
- How to pick the right ones



REACTIVITY—an interpretation by Hoot VZ

How can you use these Shell chemicals?

MANUFACTURERS of a wide variety of products are finding an increasing number of uses for these chemicals.

The products we have listed at the right may be helpful in your particular operation if you produce pharmaceuticals, adhesives, dyes, resins, pesticides or lubricating oil additives. They are available for shipment in quantities from a drum to a tank car.

Your Shell Chemical representative will gladly give you more information. Samples and technical literature are available on your letterhead request.

- Allyl Alcohol
- Allyl Chloride
- Bisphenol A
- Cyclohexane
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- Epichlorohydrin
- Ethyl Chloride
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- Styrene Monomer

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SHELL

APRIL 21, 1958

JOHN R. CALLAHAM, Editor-in-Chief

A Better Way to File

Every so often we get a challenge from our readers to do a particular job or to fill a specific need.

That happened a few months ago when we published a short letter in our Pro & Con department.

The writer, I. H. Weissman of Shell Oil, asked us to develop and publish a comprehensive but practical decimal system for classifying chemical engineering knowledge.

Mr. Weissman pointed out that such a system would help our readers in indexing CE articles and in building up their reference files.

His idea seemed sound. But we knew it would call for a major project. For one thing, few people will agree on just what's "comprehensive but practical."

What did CE readers think? So we published Mr. Weissman's letter and tagged a footnote to it asking for comments and suggestions.

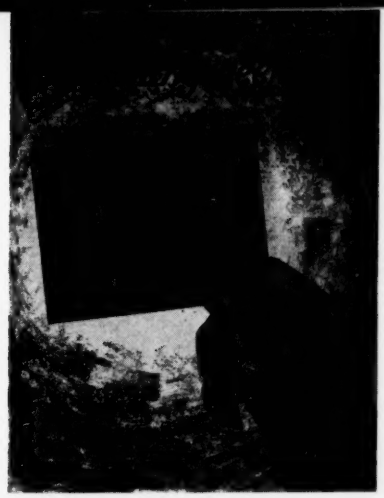
The response took us off guard. Within a few weeks we'd received close to 50 letters in favor of the idea. That was enough to start the ball rolling.

Editor Steve Danatos was given the job of handling the project. He dug in at once and started a study of present decimal systems for classifying chemical engineering. His files were soon bulging.

What about an author? Here we were lucky. An experienced chemical engineer, well known for his sound work on classification systems, agreed to tackle the job.

I'm happy to tell you that the project is under way and that we plan to publish the articles later this year.

This new series on indexing will be something you'll want to watch for, save and put to good use while building up your own files.



EIGHTH OF TWENTY-SIX ISSUES

8/26

GUIDED TOUR

How to capitalize on common nonmetallics for ultra-hot processing

One way to meet today's needs for higher and higher operating temperatures is to make better use of existing materials of construction. The problems are many and varied. But here's all you need to know about picking and using nonmetallic inorganics to turn them into everyday processing workhorses. (p. 135)

New calcining system saves three ways

Multiple savings are coming from novel system for burning cement clinker. New kiln process holds promise of fuel savings, space economies and dust reduction in other industries, too (p. 60)

Where our economy will be in 1975

Here's a spring tonic after our recession-haunted winter. It's a realistic outline of

Chemical

GUIDED TOUR

where our economy is going to be in less than 20 years. Discover the sound reasons for optimism here. (p. 86)

Almost out of this world

Here's the background on solid fuel for rocketry. A picture story of how rubber, ammonium nitrate, catalyst, plasticizers and curatives become "grains" one foot in diameter and three feet long. (p. 126)

Proper place to make mistakes

How pilot plants fit into the normal scheme of process technology. What the uses, aims, abilities and limitations of these small-scale operations are. First article of a timely series. (p. 155)

A better look at job evaluation

Why a recent report on pay policies of a single large company may be important to you, no matter what kind of a position you have, and no matter where you may be working. (p. 179)

CE is edited for the engineer concerned with chemical operations, whatever his function . . . administration, production and plant operations, design and construction, research and development, sales and purchasing. More engineers subscribe to CE than to any other magazine in the field. Print order this issue:

47,520

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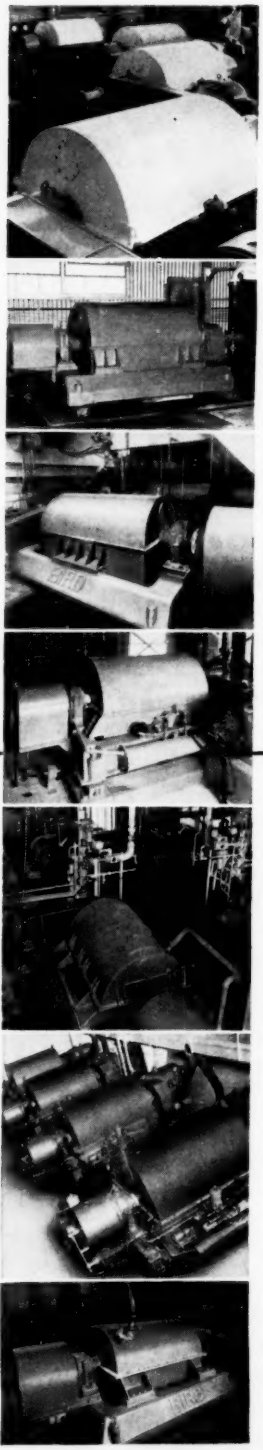
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Chemical Engineering

This issue's top features of significance in

Petrochemicals & Petroleum Refining

Coker and cracker deliver high gasoline yield 64

This refinery converts low-grade crude for a high-grade market. Pontiac Eastern's new Mississippi unit wrings 79% gasoline yield from a local sour crude.

Petrochemical units adopt airplane safety device 78

To protect synthesis gas generation facilities and personnel, some 20 to 25 petrochemical outfits now use an overheat-fire detector originally designed for skycraft.

Cost-conscious engineering → solid propellants 126

Astrodyne's solid fuel unit is keyed by a pioneer route, developed by Phillips Petroleum. It uses earthy methods much like those used for compounding rubber.

More on design for radiant heating 151

Last issue we talked about the theory of radiant and infrared heating. Now, we apply that theory to design, selection and cost of equipment to do a given job.

Much-needed series on pilot plants gets under way 155

This issue brings you part one—a general introduction to pilot plants in the process industries: What they are, what they're good for, when you can do without them.

The mechanics of mass transfer 161

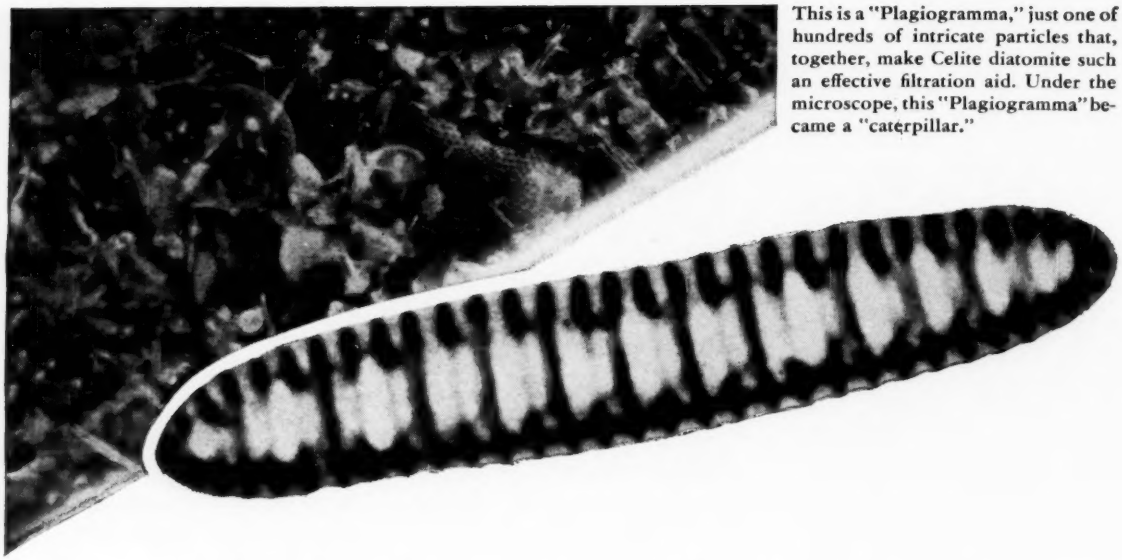
This Refresher will help you understand how driving forces, equilibrium conditions and resistances influence mass transfer and how to establish mathematical relations.

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This is a "Plagiogramma," just one of hundreds of intricate particles that, together, make Celite diatomite such an effective filtration aid. Under the microscope, this "Plagiogramma" became a "caterpillar."

What's this "caterpillar" got to do with lower filtration costs?

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Among the many important uses of Celite diatomite filter aids in industry today is the vital part they play in the production of life-saving antibiotics. Not only does Celite safeguard the purity of aureomycin, streptomycin and other pharmaceuticals; they also provide substantial cost savings that permit wider usage of these *wonder drugs.*



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-the diatomite filter aid filter surface per pound

THAT'S RIGHT. Celite* is the diatomite that gives you superior clarification at fast flow rates PLUS lower wet density. And lower wet density simply means greater surface coverage per pound of Celite. Which means substantial savings to you, for 6 bags of Celite will actually do the work of 7 bags of other diatomites.

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So if filtration belongs in your processing operations, it will pay you to call in your local J-M Celite engineer. Backed by Johns-Manville's research facilities and years of practical diatomite experience, he can help you with your filtration problems. Call him today or write Johns-Manville, Box 14, New York 16, New York. In Canada, write 565 Lakeshore Road East, Port Credit, Ontario.

*Celite is Johns-Manville's registered trade mark for its diatomaceous silica products.

JOHNS-MANVILLE PRODUCTS

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EXPERIENCE — Successful completion of the spherical reactor, other new designs and customer projects are the responsibilities of C. S. Brown, Manager of Product Development, (at right) and E. E. Deuring, Director of Product Engineering. They coordinate all phases of mechanical and process activities to *exactly* meet your specific performance requirements.

ENGINEERING

a new look in reactors

Another Glascote first brings you higher pressures and vaporization rates, larger capacity plus superior glass lining

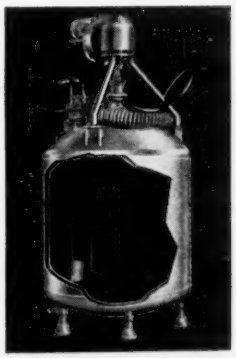
Because of Glascote's long service to the chemical processing industry, they foresaw the need for higher reactor pressures.

Heretofore, reactors could not offer the processing advantages of units capable of operating above the 200 psi ceiling. Glascote engineering accepted the challenge. They went to work . . . came up with tomorrow's design today . . . the first glass-lined spherical reactor.

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This remarkable accomplishment was executed by what we consider the finest creative engineering group in the industry. And they have demonstrated their ability many times . . . by developing these engineering firsts: Rotary mechanical seal, double wall dip tube, welded sealer rings and many others.

Why not tell us about your design, process and application problems. We'll put the same kind of engineering effort and service to work for you.



If your present processing operations do not require higher pressures, you can get the same proven engineering that produced the spherical reactor in Glascote's standard and custom-built line of glass-lined reactors, columns, storage tanks, rotary dryer-blenders, heat exchangers, pipe and fittings and accessory items.

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World's largest manufacturer of glass-lined steel products

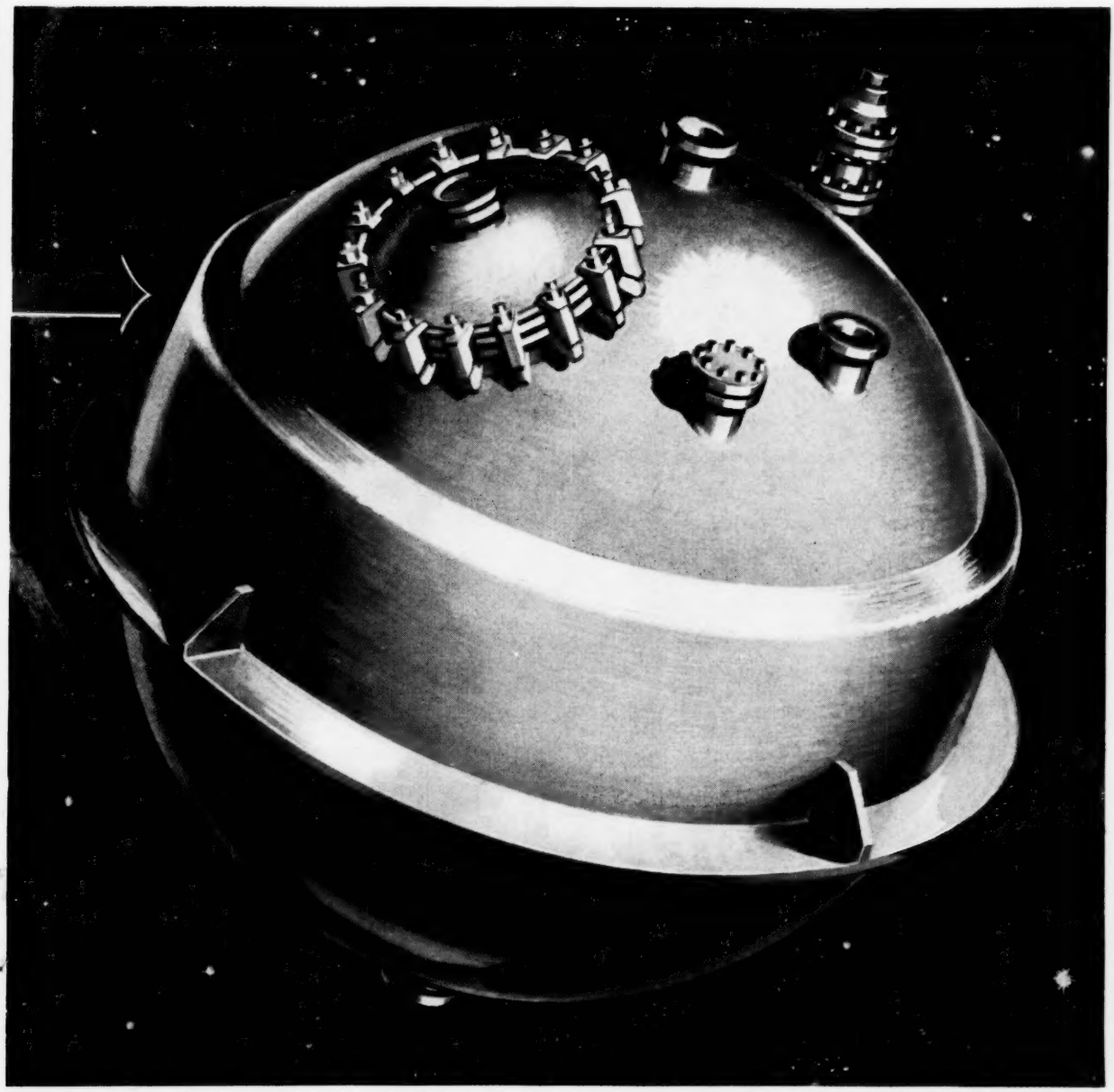
What's behind the Glascote sales engineer... and his glass-lined products?

— 38 years of Glascote experience in manufacturing glass-lined vessels and tanks for the process industries. Through continual research and development engineering, Glascote stays ahead of the demand for new and improved processes requiring a wider range of corrosion, temperature and thermal shock-resisting properties for glass linings.

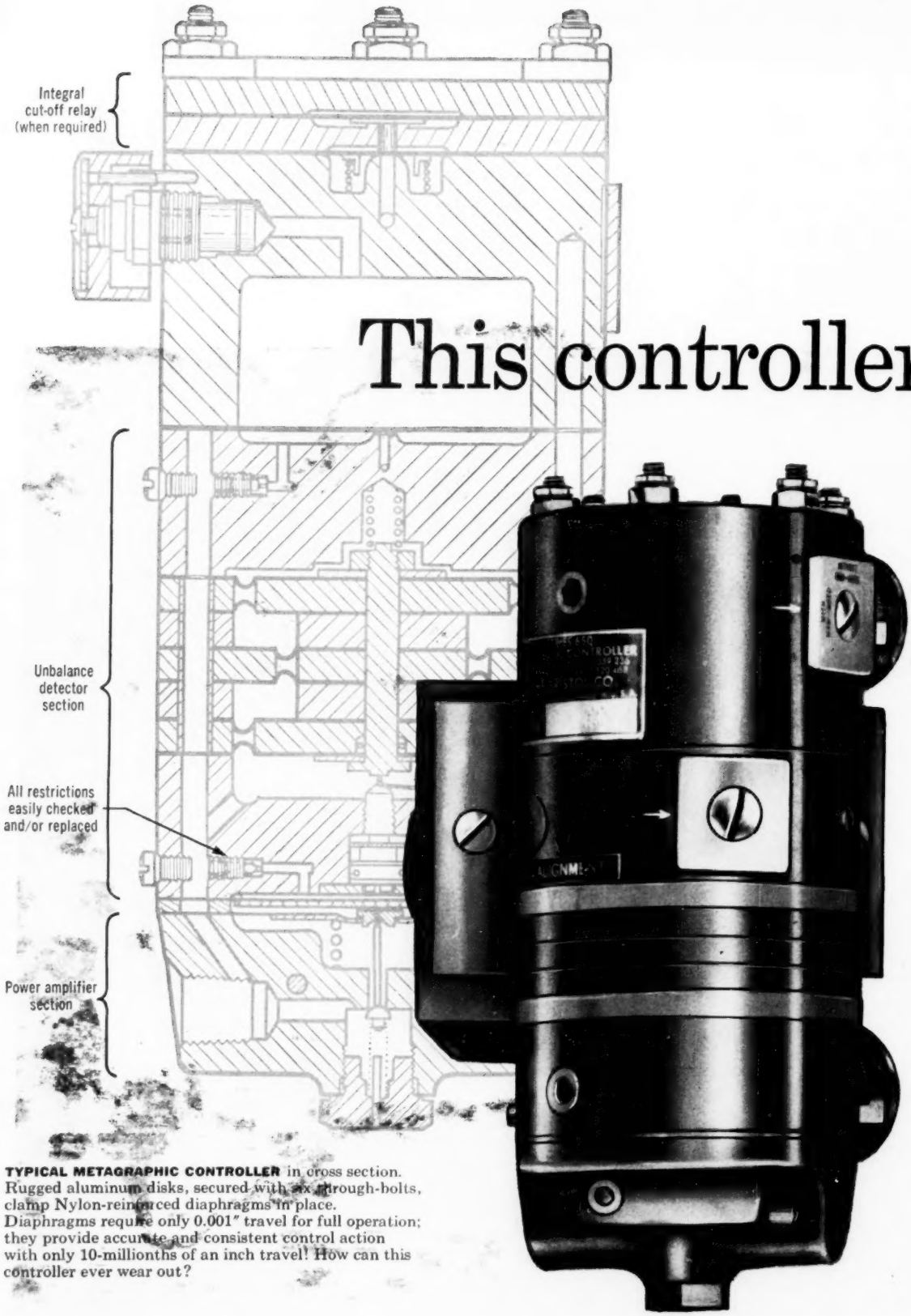
In addition, Glascote gives you preventative maintenance help, in-plant seminars . . . specialized field service. Glascote is free to call upon the 83 years of accumulated research, engineering and manufacturing experience of A. O. Smith Corp.

He's an experienced engineer who can give you on the spot product and process assistance.





This controller



TYPICAL METAGRAPHIC CONTROLLER in cross section. Rugged aluminum disks, secured with six through-bolts, clamp Nylon-reinforced diaphragms in place. Diaphragms require only 0.001" travel for full operation; they provide accurate and consistent control action with only 10-millionths of an inch travel! How can this controller ever wear out?

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Heat . . . rain . . . snow . . . ice . . .
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stays on the job!

Operates from "universal" 3-15 psi pneumatic input signal . . . supplies precision pneumatic control of almost any variable

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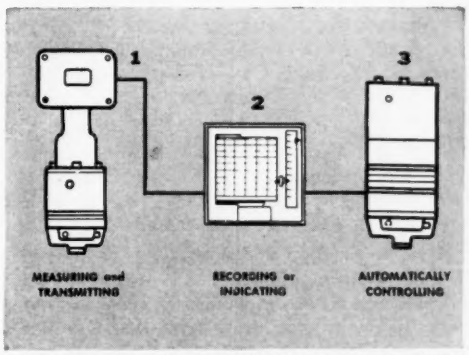
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Low air consumption – Only 0.2 scfm when balanced.

Write for complete data on the Bristol Metagraphic Pneumatic Controller today. The Bristol Company, 109 Bristol Road, Waterbury 20, Conn. 7.80



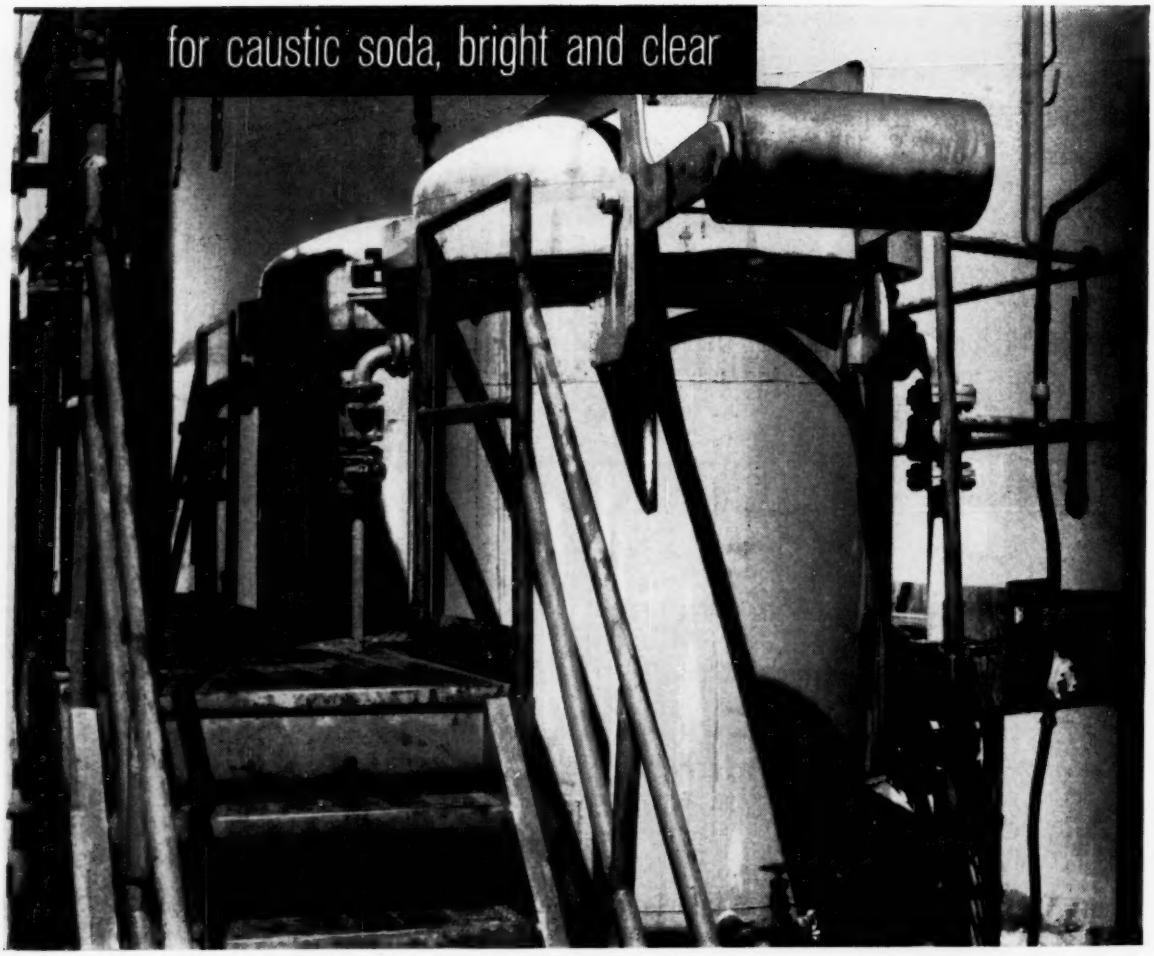
FULL PLUG-IN FLEXIBILITY for receiver mounting or field mounting allows one-minute controller substitution with no disturbance to recording or indication.



HOW BRISTOL METAGRAPHIC CONTROLLER (3) fits into complete system. Controller may be located directly at controlled process or conveniently plugged into receiver (2).

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Stauffer picks Process Filters

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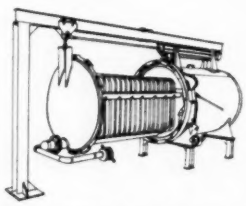
Process Filters, Inc. *(A subsidiary of Bowser, Inc.)*
1807 Elmwood Ave., Buffalo 7, N.Y.



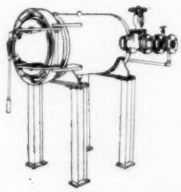
VERTICAL LEAF FILTERS
Bulletin V



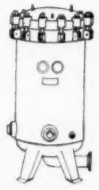
VERTICAL BATCH FILTERS
Bulletin VBO



HORIZONTAL LEAF FILTERS
Bulletin H



HORIZONTAL BATCH FILTERS
Bulletin HB



CARTRIDGE FILTERS
Bulletin C

pf

like the chimes that bring good news

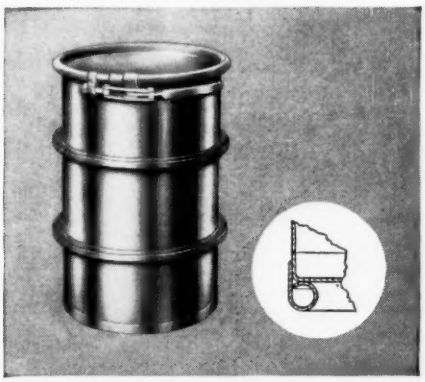


Hackney chimes bring longer profitable lives to stainless steel drums

With smooth, crack-free bottoms, reinforced by special welded chimes, Hackney stainless steel drums clean easier, save more on maintenance costs.

Whether storing or shipping foods or other products, corrosion-resistant stainless steel guards against all contamination. Durable yet lightweight, these drums cut shipping and handling costs in a hurry.

Available in 30-, 50- and 55-gallon capacities. Equipped with a single bolt type or a quick-acting Toggle-tite clamp closure to provide a liquid-tight returnable drum.



Special Hackney welded chime is easy to clean, strong and durable. I-bar hoops eliminated when a straight side container is required. Nickel or Monel drums available upon request.

Pressed Steel Tank Company

Manufacturer of Hackney Products

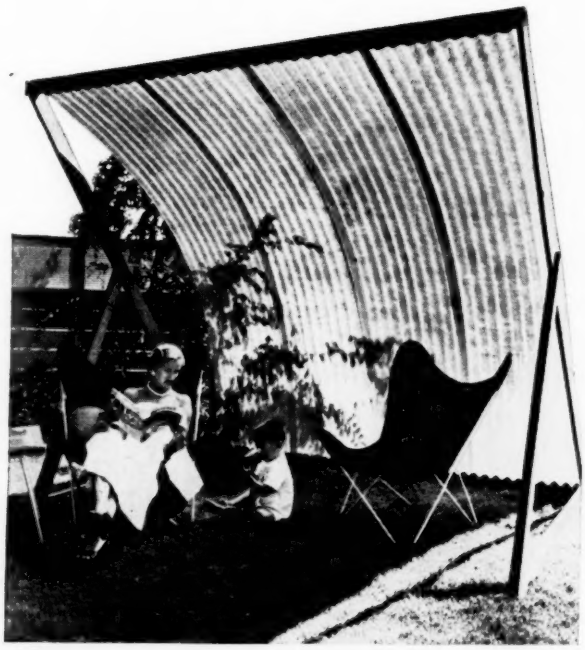
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Hackney

Life on the Chemical Newsfront



CLEARER, WHITER POLYESTERS for reinforced plastics, which are rapidly finding broader use in structural and decorative applications, can now be made with AERO* *phthalic anhydride* in its new whiter flake form. Cyanamid's phthalic anhydride offers high purity and water-whiteness for transparent or translucent polyesters. It provides exceptional clarity as an ideal base for tinted or white materials.

(Industrial Chemicals Division)

*Trademark

INTERPRETING THE CHEMIST'S WORK and its importance in our daily lives is no easy task. Cyanamid has found its on-the-spot Department Store Clinics highly effective in giving retail sales people—and through them, the consumer—a clearer understanding of the work of chemists in the improvement of textiles through modern finishes. CYANA® *textile finishes*, for example, make it possible to "tailor" fabrics for virtually any styling or use through such qualities as hand, water repellence, durability of nap and wrinkle resistance. Translating these chemical achievements into manufacture of fabrics and their proper use by consumers is an important part of Cyanamid's program.

(Organic Chemicals Division)

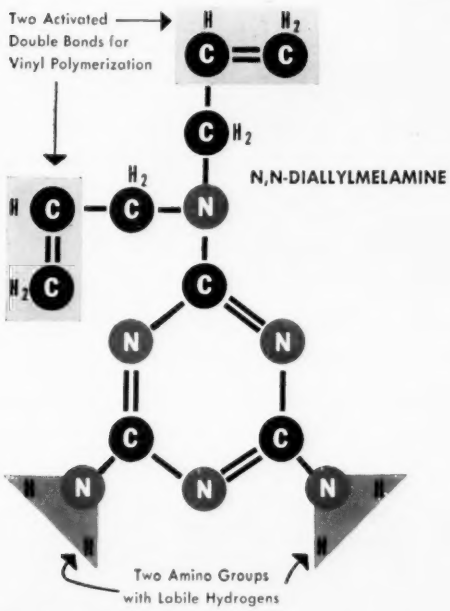


THESE PUPPETS "STOLE THE SHOW" during Paper Week at a novel introduction of Cyanamid's new HE (high efficiency) *Wet-Strength Process.*† Through this diverting device, advances in paper technology made possible by this new process were projected to 2000 A.D. Not only does the new HE Process use an average of 40% *less* wet-strength resin to produce papers fully equivalent in wet strength, it also provides a means of producing papers with properties never before obtainable. Details of this resin-saving process and its licensing can be secured through Cyanamid representatives.

(Industrial Chemicals Division)

†Patent applied for by American Cyanamid Company





THE COMBINED CAPABILITIES of vinyl polymerization, copolymerization and condensation in *N,N-diallylmelamine* lead to an unusually wide range of possible products with resin or polymer characteristics. The presence of two vinyl groupings in the same molecule offers the additional advantage of cross-linked products. Curable resins are formed when N,N-diallylmelamine is reacted with certain vinyl monomers. When reacted with acrylonitrile, a cross-linked product receptive to acid dyes is obtained. N,N-diallylmelamine-formaldehyde resins, prepared in alkaline solutions, are compatible with polyvinyl acetal or hydrolyzed polyvinyl acetate plasticizers. We will welcome your inquiry for samples and technical data.

(Market Development Department)



FINAL "COUNT-DOWN" on equipment before going on stream is made at Cyanamid's new plant for production of *aniline* at Willow Island, W. Va. This new fluid-bed catalytic reactor, first of its kind, adds 24 million pounds per year capacity to meet any foreseeable demand from the expanding industries concerned with aniline-based products. With existing capacity at Bound Brook, N. J., this additional production will assure dependable aniline service.

(Organic Chemicals Division)

CYANAMID

AMERICAN CYANAMID COMPANY

30 ROCKEFELLER PLAZA, NEW YORK 20, N. Y.

For further information on these and other chemicals, call, write or wire American Cyanamid Company

NOW

to serve modern industry's increased requirements...

Carrier

steps up the capacity range of world-famous Carrier

CENTRIFUGAL COMPRESSORS

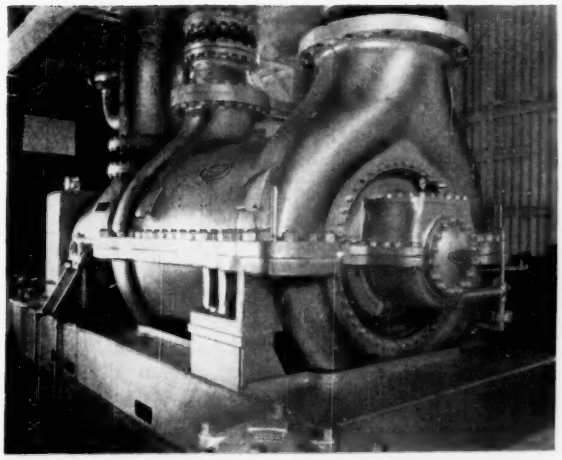
to 150,000 cfm

For thirty-five years, Carrier Centrifugal Compressors have been serving leaders of industry in refineries and chemical plants throughout the world. In that time, they have earned an outstanding reputation for dependable, efficient performance. Now this same high standard of performance is available in an expanded Carrier line of multi-stage air and gas compressors with nine frame sizes from 1000 to 150,000 cfm. Each frame size is offered in 1 to 9 stages, depending on frame size, to meet your needs.

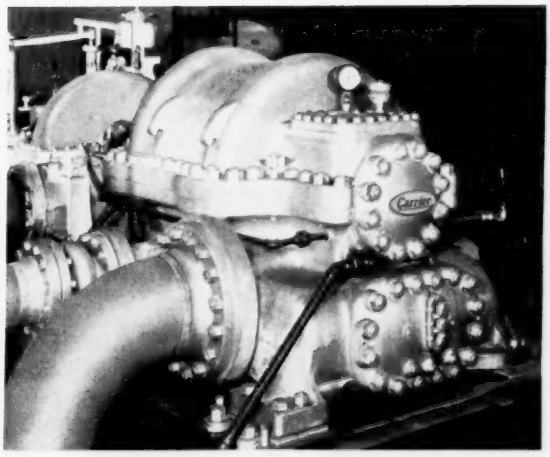
Many factors, of course, must be considered in selecting the right compressor for a job. The experience of the manufacturer is, of course, the most important. Carrier has built more multi-stage centrifugals than any other maker. Craftsmanship is important, too. Carrier has the most modern facilities for the production of centrifugal compressors. Finally, there is application skill. Carrier has handled more kinds of gases than any other manufacturer.

To make sure of getting the best compressor for your job, talk with your Carrier specialist. He will recommend the Centrifugal Compressor best suited to your needs. Call your nearest Carrier office today. Or write

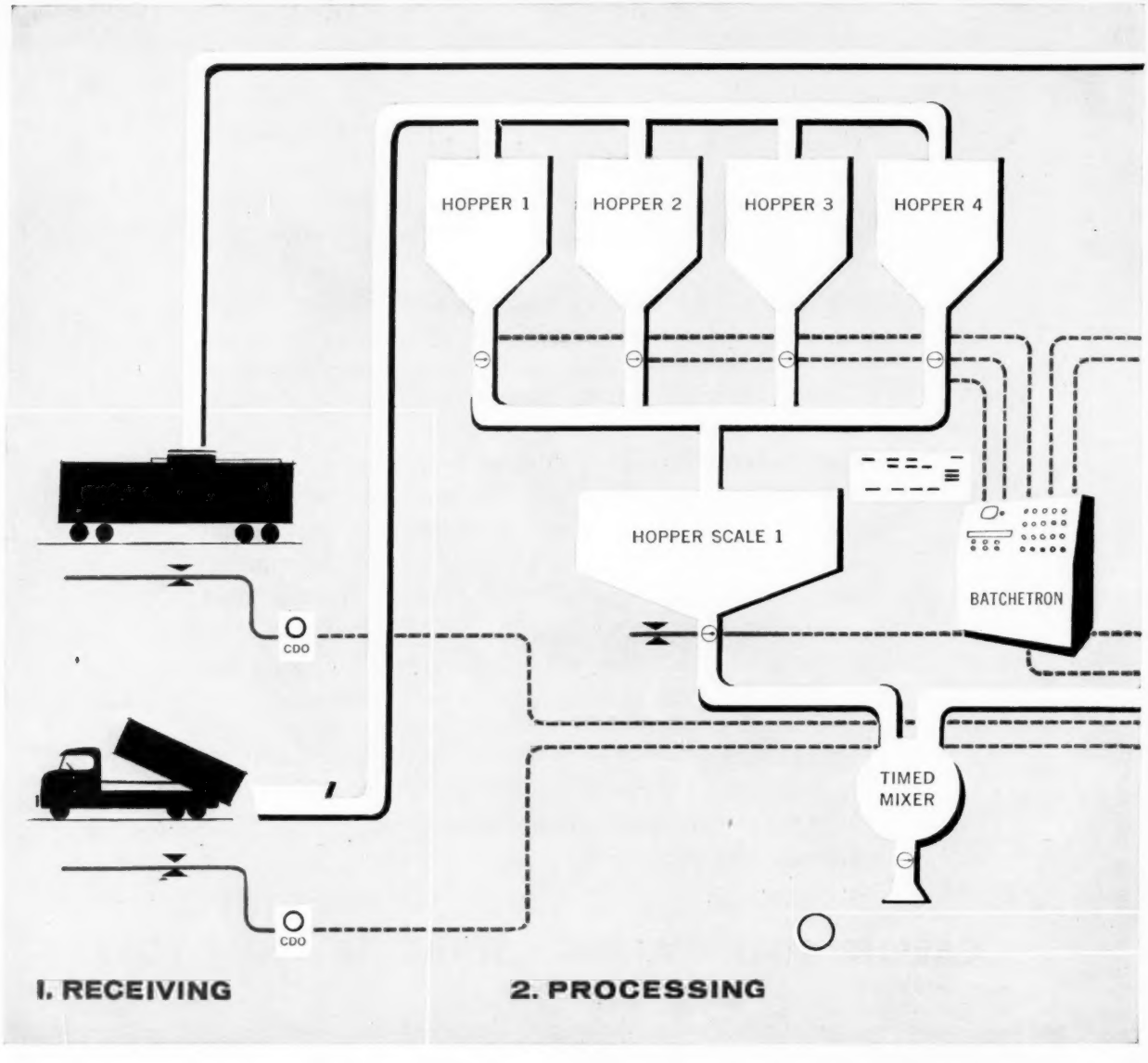
CARRIER CORPORATION · SYRACUSE · NEW YORK



For volume flow up to 150,000 cfm, Carrier now offers an expanded line of multi-stage Centrifugal Compressors for air and gas in nine frame sizes.



For volume flow starting at 1000 cfm, Carrier Centrifugal Compressors are the dependable, efficient answer. This unit is the smallest in the line.

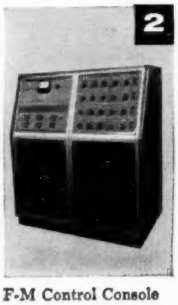


METER···MANAGE···MONITOR



Electronic Load Cell

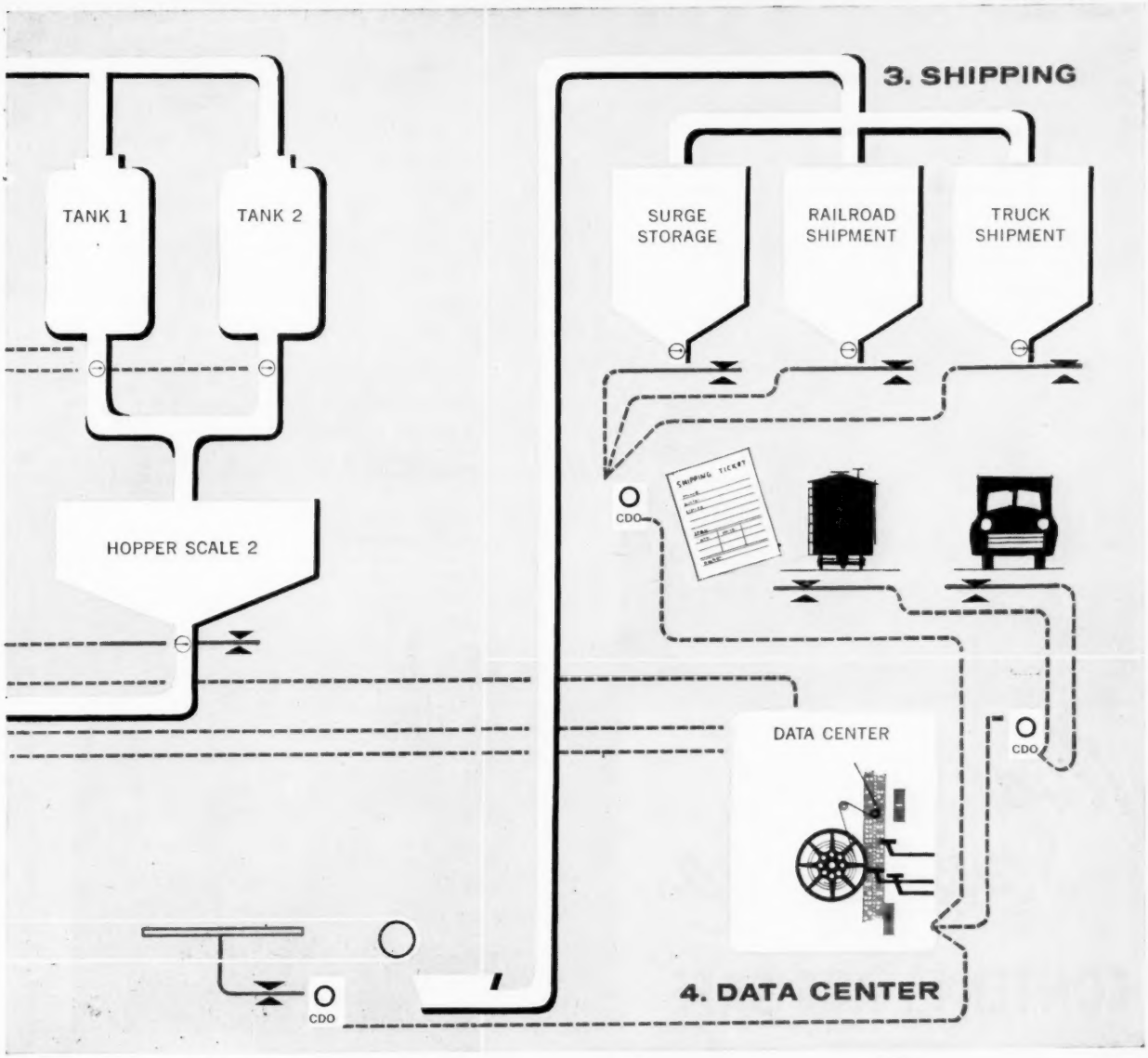
1. Starting with receiving of all raw materials, liquid and bulk, Fairbanks-Morse electronic process control can put your entire operation on a closely supervised basis—automatically. Weight data can be continually fed to current inventory records. Low supply level of any or all raw materials can automatically signal reorder requirements.



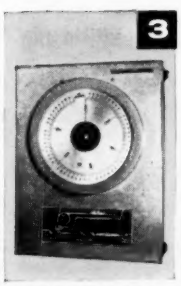
F-M Control Console

2. Flexible F-M control systems can be "fitted" to your requirements. You have widest selection of programming techniques—punched-card, tape, push-button, etc. Fully interlocked, the system is completely safeguarded against mechanical or human errors such as "double" or "off-spec" batching. Cycle of operations is easily adjusted or revised.

SCALES • PUMPS • DIESEL LOCOMOTIVES AND ENGINES • ELECTRICAL MACHINERY • RAIL CARS • HOME WATER SERVICE EQUIPMENT • MAGNETOS



with F-M ELECTRONIC PROCESS CONTROL



Visual and Printed Read-Out

3. Throughout receiving, processing and shipping cycles you can establish visual and/or printed digital read-out stations, maintaining all the advantages of full information in every department. Each shipment can generate its own shipping weight ticket as it arrives on the shipping dock.



4. Every item of variable cost...profit ...can be instantly determined as data are fed automatically from all points in the F-M control system to centrally located automatic typewriters, adding machines, billing machines and computers. F-M has the equipment, experience and the proven ability to automate your operations on a turn key basis.

FAIRBANKS-MORSE

a name worth remembering when you want the BEST

FOR FREE AUTOMATION FEASIBILITY STUDY, WRITE: FAIRBANKS, MORSE & CO., CHICAGO, ILLINOIS



RACKED OR STACKED, during shipment, handling, or storage, Republic Drums provide full-time protection of contents with the strength of steel. In addition, the new low-cost portable drum racks shown are exclusive with Republic. Each will accommodate two loaded 55-gallon drums, permitting stacking to any practical height to save valuable floor space.



Rack 'em up, Stack 'em up...

CONTENTS ARE SAFE IN REPUBLIC STEEL DRUMS

Wherever you need containers—for handling, shipment, or storage—you can assure full protection of contents by specifying strong, safe, Republic Steel Drums. Available in a wide range of types and sizes, Republic Drums provide a complete service to the chemical industry in both light and heavy gage classifications.

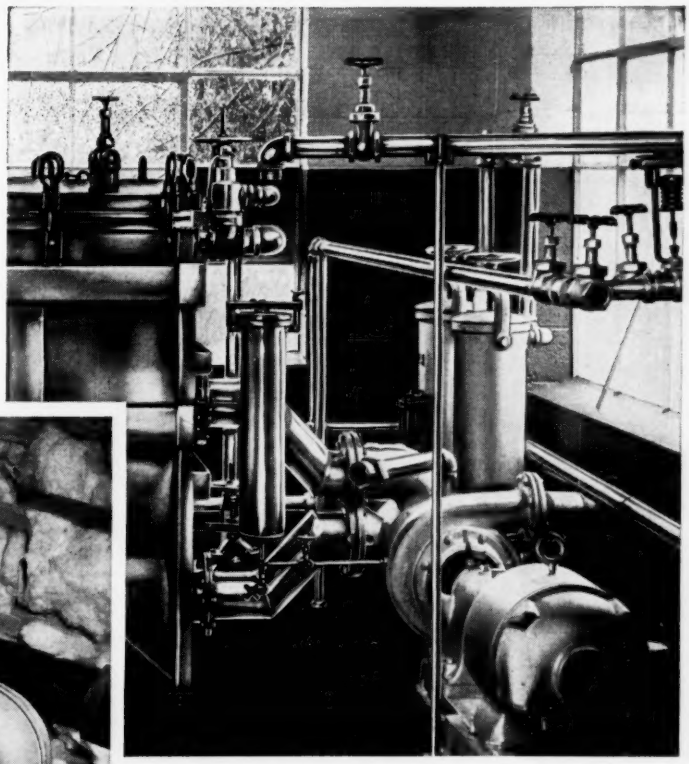
Light Gage Class I.C.C.—17E, 17H, 17C, 6J. Republic offers either tight-end or full-removable-head drums as specified. Drum bodies and heads can be decorated to order. High-bake lacquer linings are available, or drums can be hot dip galvanized or hot dip tinned to handle difficult-to-hold materials.

Heavy Gage Class I.C.C.—5, 5A, 5B, 5C, 17F and certain I.C.C.—6 Series. Drums are available in 55-, 30-, and 20-gallon capacities, from 16- to 12-gage in hot rolled carbon steel, depending on specification and service. As with the light gage service, hot dip galvanizing and hot dip tinning can be provided. In addition, Republic offers containers made of ENDURO® Stainless Steel for the ultimate in long-lasting, trouble-free, corrosion-resistant performance.

Republic also produces a full line of Steel Packages from 3½- to 20-gallon capacities. Gages range from 26 to 20 in plain steel. Decoration and special high bake linings can be applied to meet individual requirements.

It will pay you to assure full protection for your materials with Republic Steel Drums. For detailed literature, send coupon.

SAFE HANDLING OF NUMEROUS CHEMICAL FLUIDS is no problem when you install Republic ELECTRUNITE® ENDURO Stainless Steel Pipe and Tubing. In this mill, ELECTRUNITE Pipe carries dye solutions without danger of contamination or loss. This strong, quality pipe offers great resistance to heat, rust, and corrosion—is a dollar-wise investment in long-range economy. Send coupon for facts.





REPUBLIC SRK PLASTIC PIPE has proved ideal for use with many chemically active agents. SRK (Semi-Rigid Kralastic) is inexpensive, light in weight, and exceptionally strong. It's easy to install, even in cramped quarters. Can be cut with ordinary hand saw. Joints are made with brush-applied solvent and socket-type fittings—or threaded male and female adapters can be furnished for conventional joining. For details, mail coupon.

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REPUBLIC STEEL

World's Widest Range of Standard Steels and Steel Products

REPUBLIC STEEL CORPORATION
DEPT. CE-5501
1441 REPUBLIC BUILDING • CLEVELAND 1, OHIO

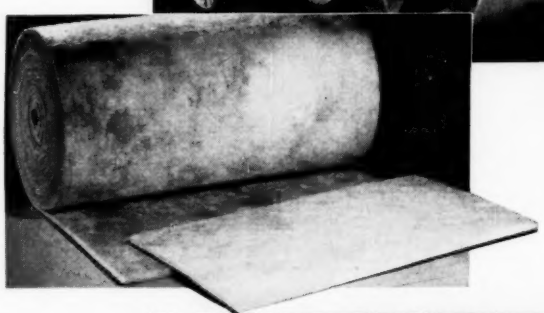
Please send me more information on:
☐ Steel Drums and Packages ☐ Portable Drum Racks
☐ ELECTRUNITE ENDURO Stainless Steel Pipe and Tubing
☐ SRK Plastic Pipe

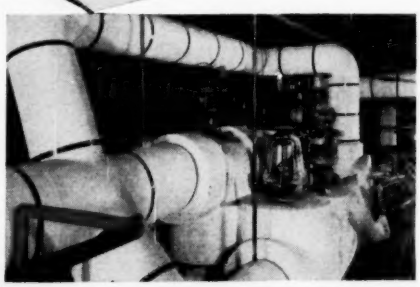
Name_____ Title_____
Company_____
Address_____
City_____ Zone____ State_____

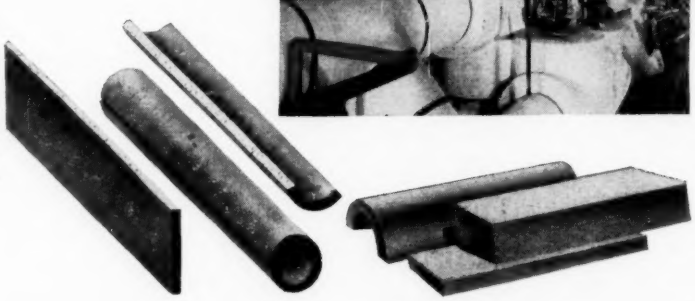
NOW with SUPERGLAS

EAGLE-PICHER has a FULL LINE of *Industrial and Commercial* INSULATIONS









No matter what the application, there's now an Eagle-Picher insulation to do the job best. Choose the basic material you prefer—mineral wool, magnesia or Eagle-Picher's latest, SUPERGLAS. These materials give you a complete choice of pipe insulations, blocks, blankets, felts and cements.

Superglas Insulations

Have low bulk, low application costs, few maintenance problems. Won't shrink, warp or buckle. Available in a wide variety of shapes, types, sizes, thicknesses and densities for pipe, duct and equipment installations. Effective at temperatures from minus 120 F to 400 F. Numerous finishes and facings for pleasing appearance in exposed installations.

85% Magnesia and Hylo Insulations

Extremely light weight with low conductivity, great strength and high dimensional stability. Easily workable, retains high thermal efficiency. Available in pipe section and blocks.

Mineral Wool Insulations

These mineral wool and cement insulations provide maximum thermal efficiency for temperatures ranging from below zero to over 2000 F.

PV SUPERTEMP BLOCKS — an all purpose, true-cut block with *precision finish*. Combines efficiency, durability and great strength. Lightweight, easily installed, resists steam and other moisture.

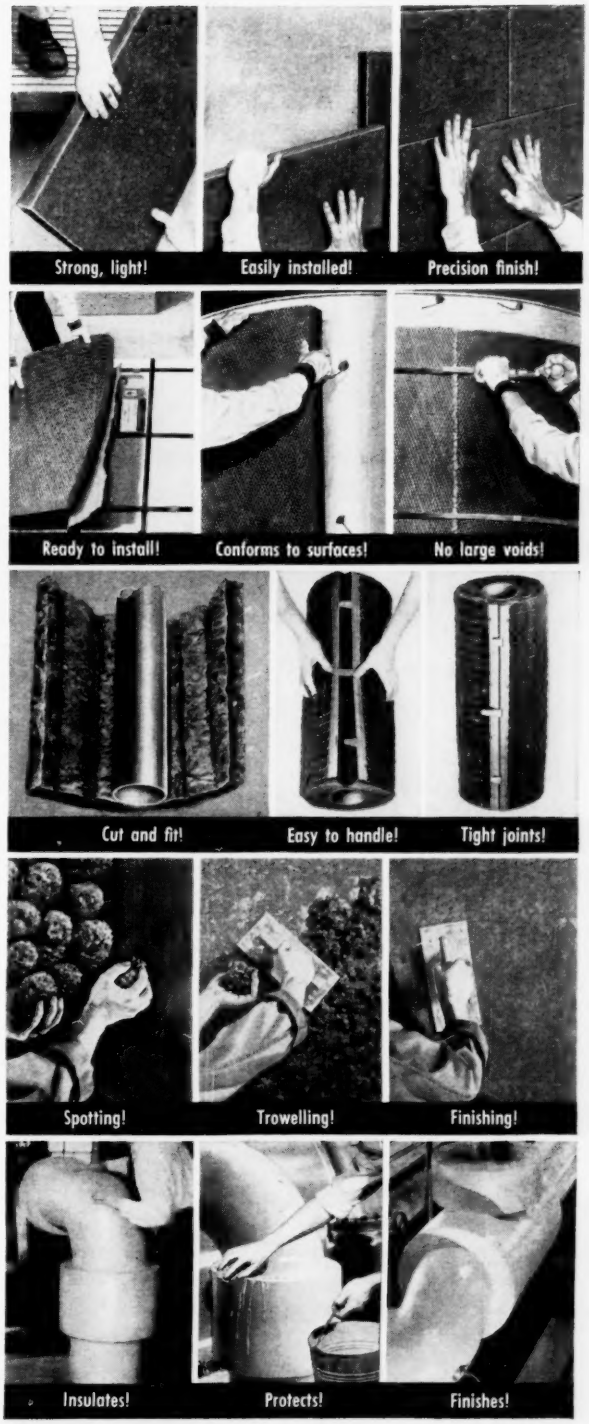
BLANKETS—factory fabricated to *rigid specifications*. Blankets are completely free of large voids. Smooth edges butt tightly together. For application to flat or slightly curved surfaces, can be cut to fit irregular areas.

TAB-LOK—a high temperature pipe insulation *easy to apply*. Precision made, tab-and-slot feature assures tight, close butted joints. Water-repellent, corrosion, fire, and vibration-resistant. No reinforcing needed. Saves time and labor.

SUPER "66" CEMENT—*sticks to hot or cold surfaces.* Makes difficult jobs easy. Maximum coverage with no reinforcing needed on applications up to 1½ inches thick. Special rust inhibitor prevents corrosion.

ONE-COTE CEMENT—one quick application *insulates, protects, finishes.* Clean, easy to handle. For indoor or outdoor application. Applied to hot or cold surfaces. Quick setting, resists rain and moisture two hours after application. Prevents rust.

We will be glad to send you complete data on our comprehensive line of insulations for all industrial and commercial applications. WRITE TODAY!

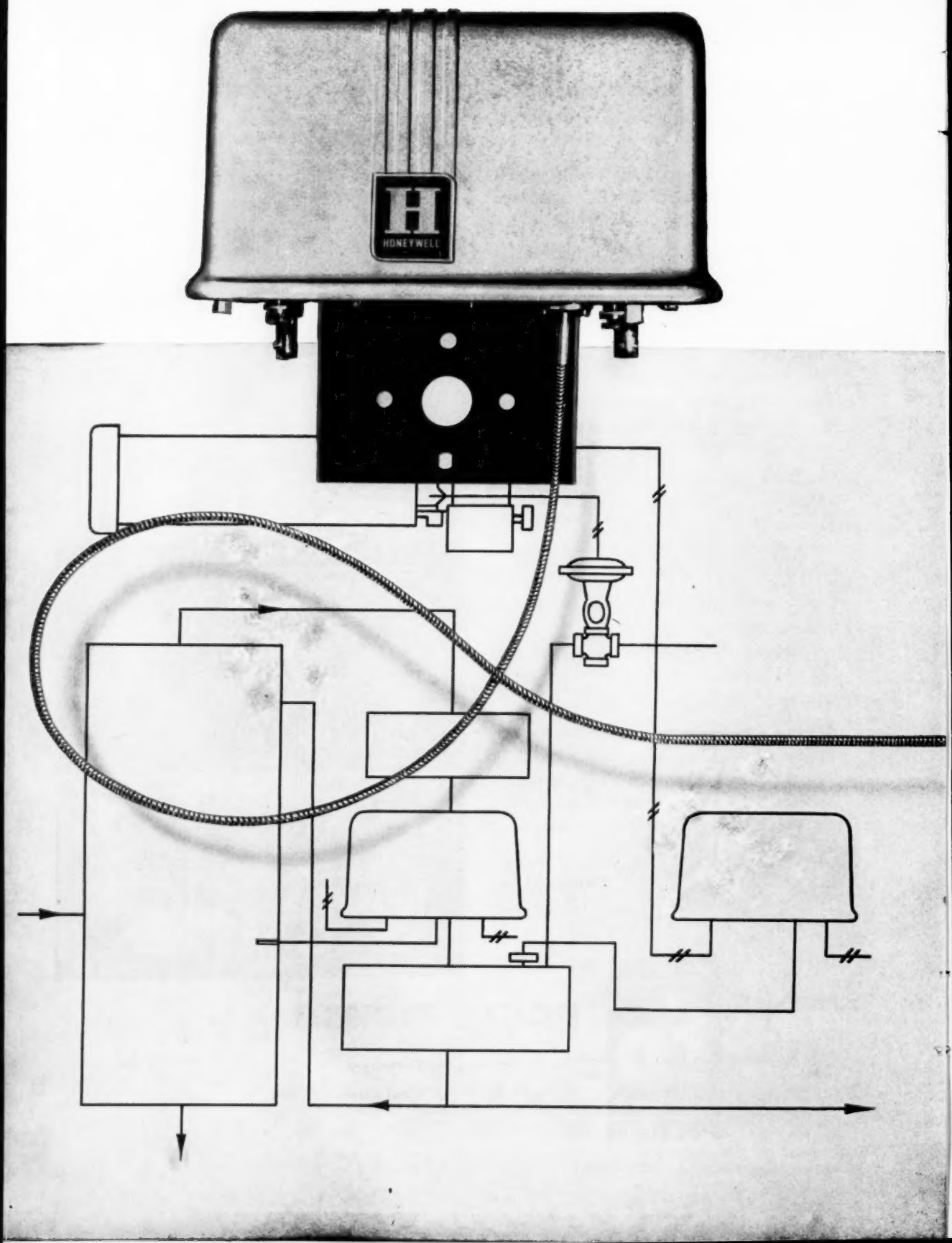


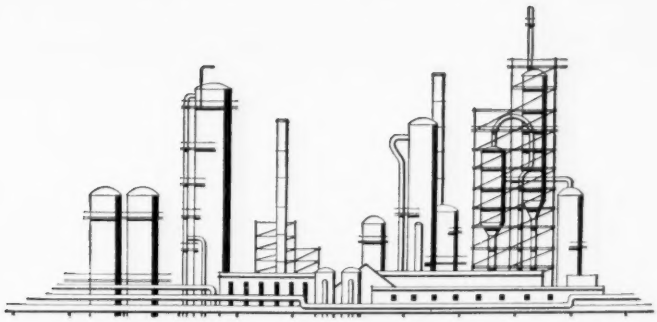
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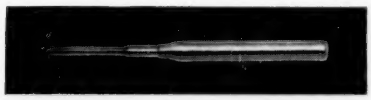
The Eagle-Picher Company
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HONEYWELL

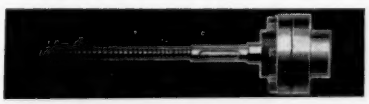


One basic TEL-O-SET transmitter serves all applications

TEMPERATURE SENSING ELEMENT has small bulb for fast response. Either plain or coiled bulbs are standard, with or without union connections. For food processing applications, bulb is available with union connection for Type 3A4 sanitary fitting.







PRESSURE SENSING ELEMENT—a sealed volumetric pressure unit with stainless steel diaphragm and flange protects the transmitter from corrosive material, and damps line pulsations.

- Measures temperature, gage pressure or absolute pressure.
- Requires only one thermal system and one pressure system for all ranges. Changeover from temperature to pressure measurement is extremely simple.
- Span can be shifted to cover any part of the overall transmitter range—from 40 to 600 psi, or from –375 to 1000°F—*without changing or adding parts.*
- Equally accurate at small spans of 20 psi and 50°F or at wide spans of 150 psi and 400°F.
- High-speed response to temperature or pressure changes permits control within close tolerances.
- Ambient temperature and pressure compensated. Vibration resistant.

Get complete details on *Tel-O-Set* transmitters . . . and related *Tel-O-Set* miniature indicators, recorders and controllers . . . from your nearby Honeywell field engineer. Call him today . . . he's as near as your phone.

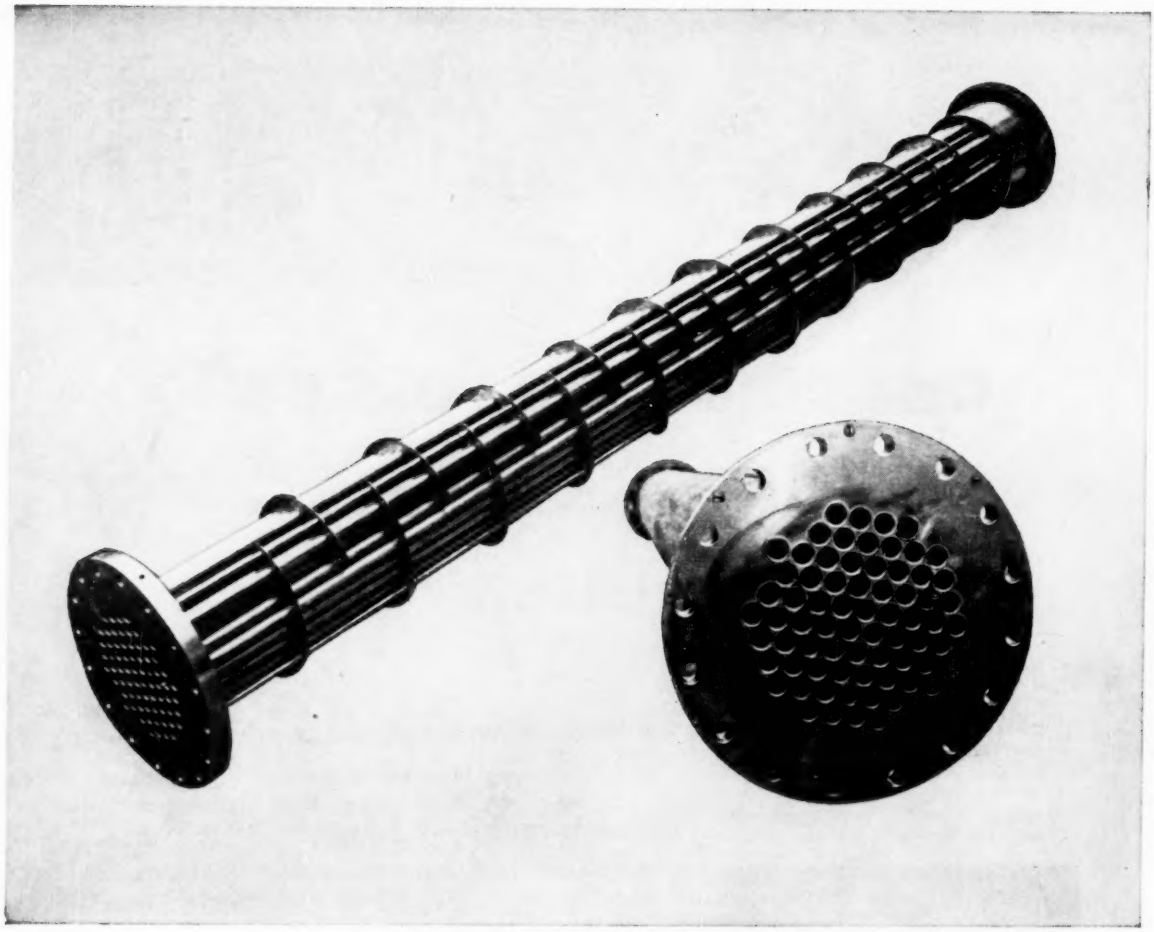
MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Products Group*, Brown Instruments, Wayne and Windrim Avenues, Philadelphia 44, Pa.

● **REFERENCE DATA:**
Write for Specification S1003-1

Honeywell

H HONEYWELL *First in Controls*

TITANIUM–available now for long service



• *The life of this titanium 70-tube condenser assembly, now handling 60% nitric acid at 195° C. and 180 psi, is estimated to exceed 10 years.*

Titanium condenser tubes expected to outlast stainless 30 to 1 handling nitric acid

Corrosive vapors of 60% nitric acid gnawed through an average of three stainless-steel tube bundles a year in a chemical firm's condenser. Maintenance and replacement costs were running as high as $18,000 a year. Then titanium tubes were installed. Based on a service life of 10 years, titanium will save at least $162,000 in maintenance and replacement costs.

life . . . corrosion resistance . . . economy in use

Proven economies

Titanium is actually the *least expensive* metal you can use under many corrosive influences. Titanium withstands conditions that reduce the service life of ordinary metals . . . assures minimum downtime of equipment, fewer replacements.

Titanium offers the economy of long, trouble-free service when exposed to such corrosive environments as:

Salt Water
Marine Atmospheres
Nitric Acid
Wet Chlorine
Chlorinated Organic Compounds
Most Inorganic Chloride Solutions
Molten Sulfur
Chromic Acid
Aqua Regia
Hypochlorites & Chlorine Dioxide

TITANIUM—available today

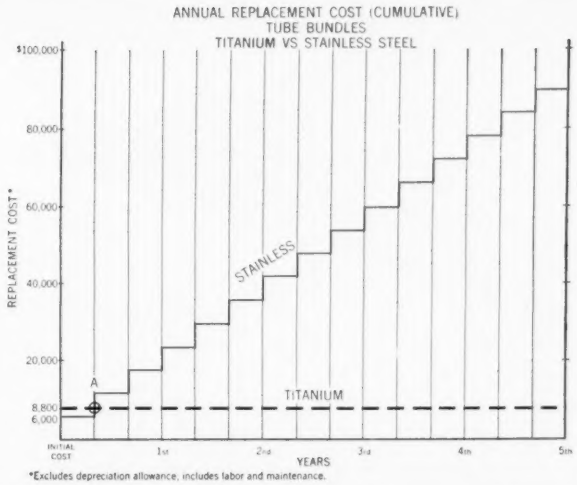
Titanium is now readily available for non-defense applications. Through research and technical developments by process-equipment manufacturers and mill-product producers in cooperation with Du Pont, standard parts can now be made to specifications. Titanium equipment is already solving severe corrosion problems in a number of industries—chemical, food, pulp, paper and allied industries.

In your process-development work, take full advantage of the corrosion and cavitation resistance, light weight and high strength of titanium . . . important considerations for continuous flow, high temperature and pressure processes. For further information, get in touch with Du Pont. And be sure to mail coupon below for an informative booklet about titanium—its properties and applications. E. I. du Pont de Nemours & Co. (Inc.), Pigments Department, Titanium Market Development Section, Wilmington 98, Del.

PIGMENTS DEPARTMENT

DU PONT
REG. U. S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*



INITIAL AND ANNUAL REPLACEMENT COSTS of titanium and stainless tube bundles are compared above. Initial cost of the titanium tube bundle, shown at left, is $8,800, vs. $6,000 for stainless. But note how the $2,800 difference is absorbed within 4 months of service (Point A). Savings are approximately $81,000 after 5 years . . . $162,000 after 10 years, the expected service life of titanium tubes.



NOW AVAILABLE, titanium parts and fittings like this 4" gate valve, chemical pump and centrifuge can be made to your order by process-equipment fabricators.

If you have a corrosion problem and need additional information, mail this coupon for titanium booklet.



Please send me more information on titanium. I am interested in evaluating titanium for these applications:

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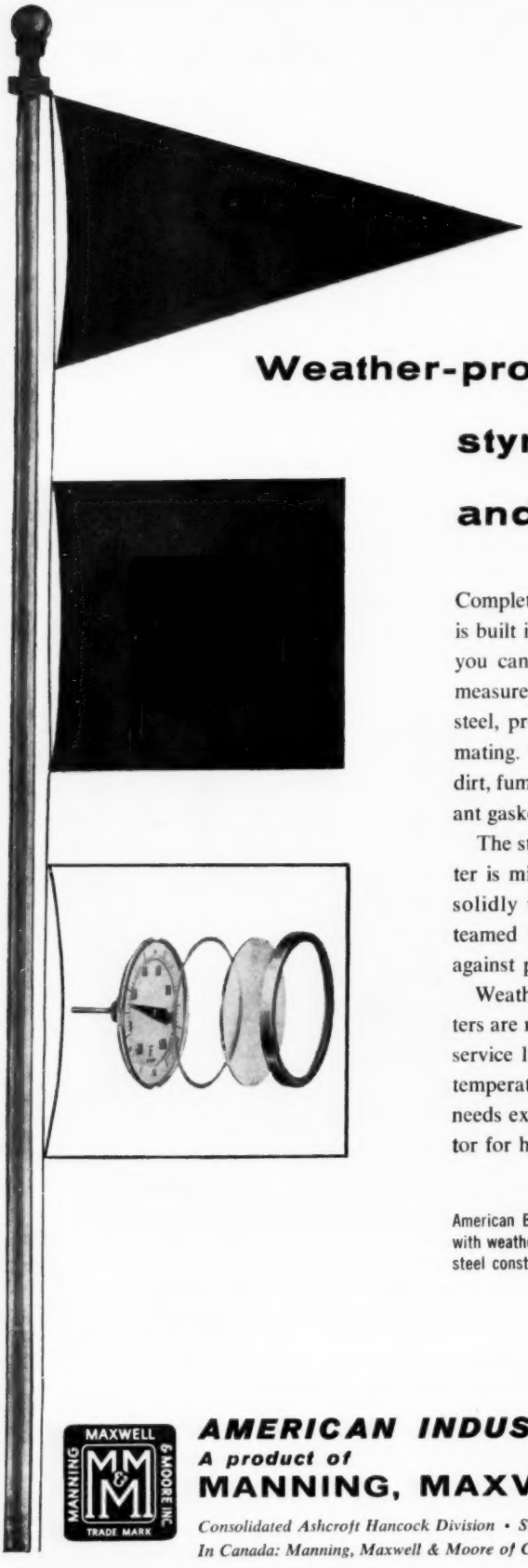
E. I. du Pont de Nemours & Co. (Inc.)
Titanium N-2496, CE-4, Wilmington 98, Delaware

*Name*_____ *Title*_____

*Firm*_____

*Address*_____

*City*_____ *Zone*____ *State*_____



Weather-proof construction stymies erosion and corrosion

Complete protection against erosion and corrosion is built into American Bi-Metal Thermometers, so you can always be sure of accurate temperature measurement. Both case and bezel are stainless steel, precisely fitted and gasketed to insure snug mating. Whatever the weather, rain, sand, dust, dirt, fumes and frost are sealed out by a heat-resistant gasket between case and thick cover glass.

The stem of the American Bi-Metal Thermometer is mirror-smooth stainless steel. All joints are solidly welded. Top resistance to corrosion is teamed with strength, rigidity and tight closure against process pressures.

Weather-proof American Bi-Metal Thermometers are noted for high sustained accuracy and long service life. There are mounting styles, dial sizes, temperature ranges and stem lengths to meet your needs exactly. Ask your industrial supply distributor for help in proper selection.

American Bi-Metal Thermometer with weather-proof stainless steel construction.



MANNING MAXWELL & MOORE INC. TRADE MARK

AMERICAN INDUSTRIAL THERMOMETERS

A product of

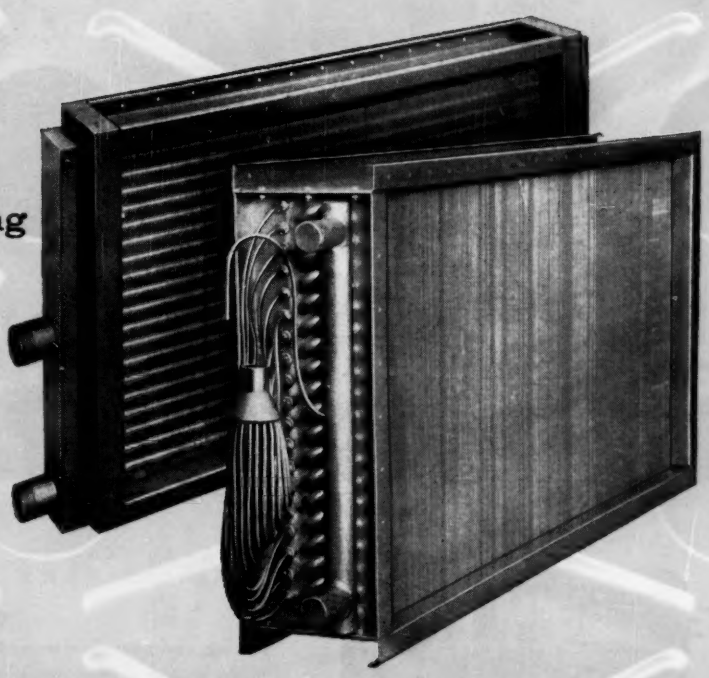
MANNING, MAXWELL & MOORE, INC.

Consolidated Ashcroft Hancock Division • Stratford, Connecticut

In Canada: Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario

When you need heating and cooling coils...

these are better



because of this!

Air Activating Guides

This Westinghouse fin design activates air ... does away with dead-air film

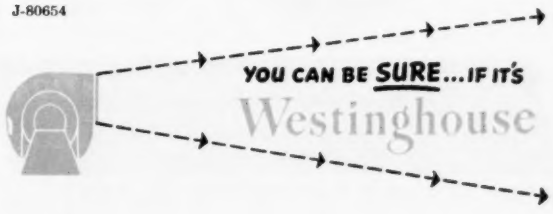
All Westinghouse continuous Plate-Fin Coils feature:

- *Permanent Mechanical Bond—Fin to Tube*
- *Minimum Air Resistance*
- *Guaranteed Published Performance*
- *Wide Selection*

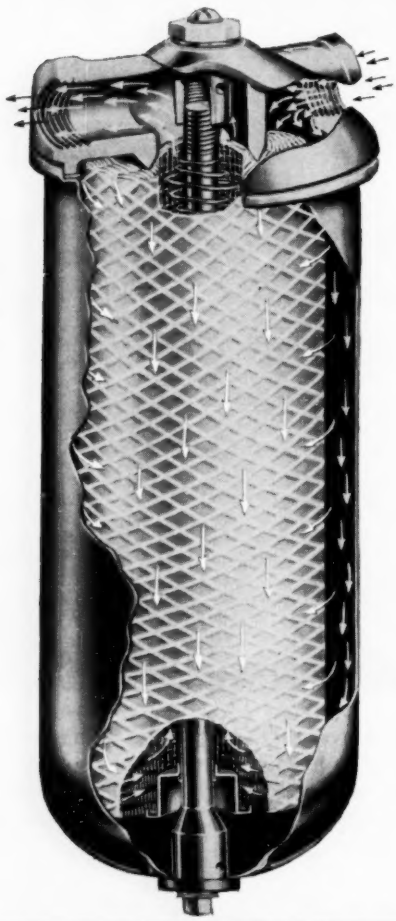
And for heavy-duty industrial process and high-pressure steam heating . . . standard sections with extra-heavy wrought-iron finned pipe are available.

Call your Sturtevant Division Sales Engineer for complete details on your heating and cooling coil requirements, or write Westinghouse Electric Corporation, Department D-4, Hyde Park, Boston 36, Massachusetts.

J-80654







Strong, compact, low in cost — the new SSB10 Fulflo Filter is made with a rugged one-piece drawn shell of #316 stainless steel. Simplified construction is reflected in exceptionally low price. Use this Fulflo Filter for every operation requiring stainless steel protection against chemical attack and oxidation: liquid chemicals; petro chemicals; pharmaceuticals; beverages; water; oils; liquid fuels; compressed air, CO_2 and other gases.

The new Fulflo Filter provides continuous micro-clarity of liquids or gases at operating pressures up to 150 psi. Flow rate is 2½-5 gpm for liquids of aqueous viscosity. Two pipe sizes — ⅜ and ¾ inch. Air vent and drain plug included.

To resist solutions chemically hostile to cotton, 10-inch Honeycomb Filter Tubes are available in a variety of synthetic fibres: nylon; orlon; dacron; dynel; acetate; or glass. Wide range of densities enables you to get the exact degree of micro-clarity your operation requires. Honeycomb Filter Tubes have hundreds of precision controlled filtering tunnels to provide true *depth* (not just surface) filtration. These diamond-shaped tunnels are engineered for absolute uniformity in size, shape, depth and density.

Other Fulflo Filters include steel-and-iron, steel, stainless steel, rubber-lined steel and nickel-plated brass models for high or low flow rate, pressure, *p*H, viscosity, temperature.

For technical literature, write to Department CE.



COMMERCIAL FILTERS CORPORATION
MELROSE 76, MASSACHUSETTS
PLANTS IN MELROSE, MASSACHUSETTS AND LEBANON, INDIANA

MICRO-CLARITY AT MINIMUM COST

Fulflo FILTERS
with genuine Honeycomb Filter Tubes for controlled micro-clarity of industrial fluids.

CFC FILTERS
Selective filtration of oils • water-oil separators • magnetic separators • pre-coat filters • coolant clarifiers • automatic tubular conveyors.

for the most efficient recovery* of platinum metals . . .



THE WORLD'S LARGEST WORKERS AND REFINERS OF PRECIOUS METALS

The maximum recovery of platinum metals from spent catalyst is a specialized problem. Percentage of recovery and rapidity of service are *important considerations.*

Here, special procedures recover 100% of assayed platinum metals content—personnel and plant are geared for prompt recovery.

★ Our facilities for the manufacture of platinum metals catalyst are among the largest in the world. Qualified research personnel are at your service to advise on the concentration of metal, form and carrier best suited to your production.

All data of confidential nature are of course treated accordingly.

IN MIXERS...tough buyers look at the bearings

Specifically, they look for oversize, heavy duty, high capacity bearings like the ones in this Philadelphia Mixer.

Their reasons are many. Oversize bearings mean the mixer will easily take maximum thrust and heavy unbalanced mixing loads.

Extra large bearings permit extra large output shafting. Shaft deflection is kept to an absolute minimum. Stuffing boxes need less maintenance. Mechanical seals last longer. You don't need steady bearings in tank bottoms.

Heavy duty inboard bearings give extra rigid support. Shaft run-out is minimized. Spiral gears run more smoothly . . . have longer life.

Oversize thrust bearings mean you can use standard Philadelphia Mixers for high pressure, closed tank applications.

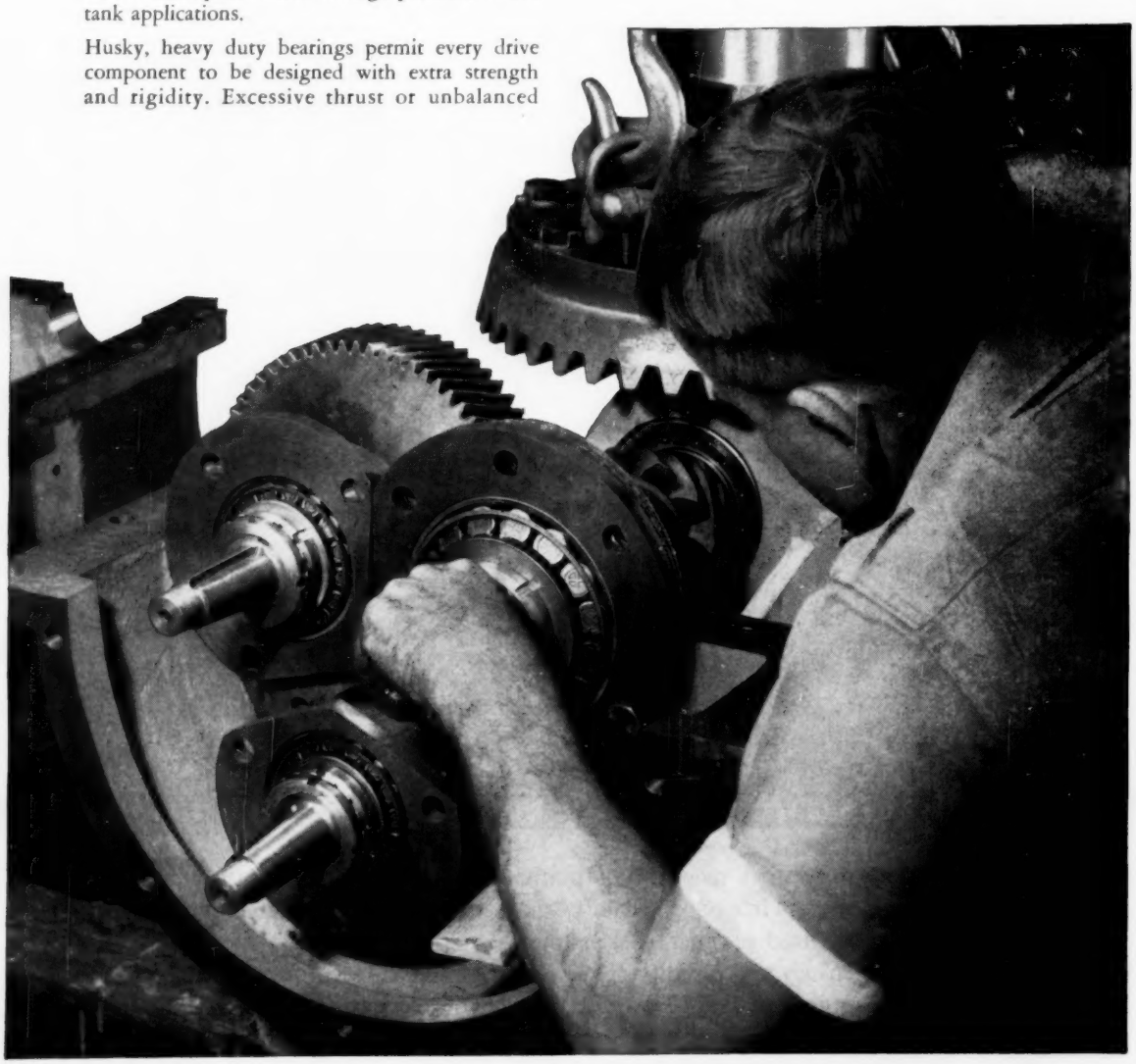
Husky, heavy duty bearings permit every drive component to be designed with extra strength and rigidity. Excessive thrust or unbalanced impeller loads simply can't cause shaft deflections which might damage the gearing.

Tough buyers look at the price too. And, you'll pay no premium for a Philadelphia Mixer. We are the only manufacturer that designs and builds the whole mixer. We control production and costs. We can *afford* to give you more mixer per dollar.

Write for Catalog A-27. It contains all the information needed for you to select your own Philadelphia Mixer. Philadelphia Gear Works, Erie Ave. and G Street, Philadelphia 34, Pa.

philadelphia mixers

Offices in Principal Cities



WOLVERINE
TUBE
Items of Interest to the Processing Industry

PUBLISHED BY WOLVERINE TUBE DIVISION

HOW TO LICK 3 PROBLEMS WITH 1 CONDENSER TUBE

BY ERNEST DODD

Solving three major heat transfer problems with one product is the neat trick performed recently by CALIFORNIA STEEL PRODUCTS, Division of Yuba Consolidated Industries, Inc., when fabricating a battery of six U-bend shell and tube heat exchangers for one of its West Coast customers. The units were to be used in jacket water-crude oil cooler service.

The problems: reduce unit size, slash unit costs, and increase unit service life. The product involved was electric-welded steel Wolverine Trufin® Type S/T condenser tubing in U-bend form. Here's how—and why—this product of Wolverine Tubemanship was able to help CALSTEEL accomplish its objectives.

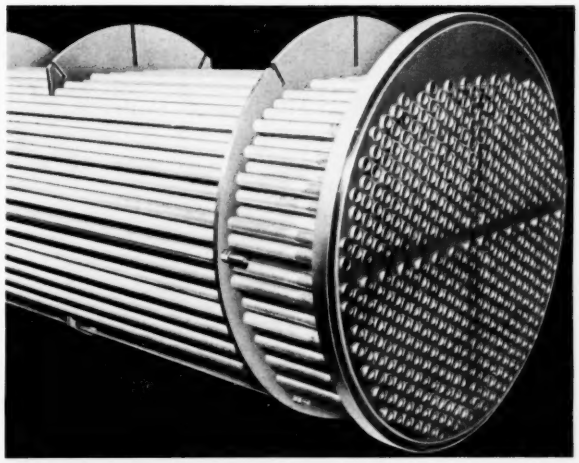
Because it is an extended surface tube with fins actually extruded from the tube wall, Trufin Type S/T has approximately 2½ times more heat transfer surface than does plain tube. It packs more heat transfer surface into a given area—permits the design of smaller and more powerful heat exchangers.

This greater surface area also means that Type S/T requires fewer tubes to handle equivalent heat duty. This means a substantial savings in direct tube costs. Fewer tubes also permit the use of smaller shells, heads and baffles with a consequent saving in material costs. This in turn brings a reduction in labor costs because of fewer rolling in operations.

Although operation of crude oil coolers is regarded as dirty service, similar applications where Trufin Type S/T electric-welded condenser tubes have been used have proven conclusively that Trufin tubed units stay on stream considerably longer than plain tube exchangers. Designers have discovered that the configuration of Trufin's extended surface is less conducive to scale build up than that of plain tube. Scaling tends to follow the contour of the fins, forming in many cases, an extended projection of the fin that contributes to self shedding. This assures reduced maintenance and increased on stream time.

In addition, CALSTEEL also helped itself to still greater savings and convenience when it specified Trufin Type S/T in U-bend form.

Wolverine pre-fabricates its U-bend condenser tubes to customer specifications—ships them in the exact order of their installation in disposable pallets. All the user has to do is insert them directly into the unit. This reduces inventory, saves floor space and cuts downtime.





Your company, too, can realize similar savings in money, time and convenience by specifying Wolverine Trufin Type S/T condenser tube. Next time you retube existing equipment or consider the design of new units, be sure to specify *Trufin*.

SEND FOR FREE BOOK

Wolverine's Trufin Catalog is filled from cover to cover with valuable information concerning integrally finned condenser tube. Processing engineers and design engineers alike will find here one of the most comprehensive sources for such finned tube data as types, sizes, alloys, end finishings, fabrication techniques, standards, and applications. Write for this valuable book today!



As Near as your Telephone

For the convenience of its customers Wolverine Tube maintains sales offices in the cities listed below. You'll find the addresses and telephone numbers listed in the yellow pages of your telephone directory. For complete information about Wolverine Trufin or other Wolverine products just call the sales office nearest you:

ALBUQUERQUE, NEW MEXICO
ATLANTA, GEORGIA
BIRMINGHAM, ALABAMA
BOSTON, MASSACHUSETTS
CHARLOTTE, NORTH CAROLINA
CLEVELAND, OHIO
COLUMBUS, OHIO
DALLAS, TEXAS
DAYTON, OHIO
DECATUR, ALABAMA
DENVER, COLORADO
DETROIT, MICHIGAN
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JACKSONVILLE BEACH, FLORIDA
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BUY WOLVERINE TUBE—IT'S MADE IN AMERICA!

CHECK THESE APPLICATIONS

Listed below are a few of the many applications where Wolverine Trufin is providing new concepts of economical heat transfer operation. Look them over and we're sure you'll find operations similar to your own.

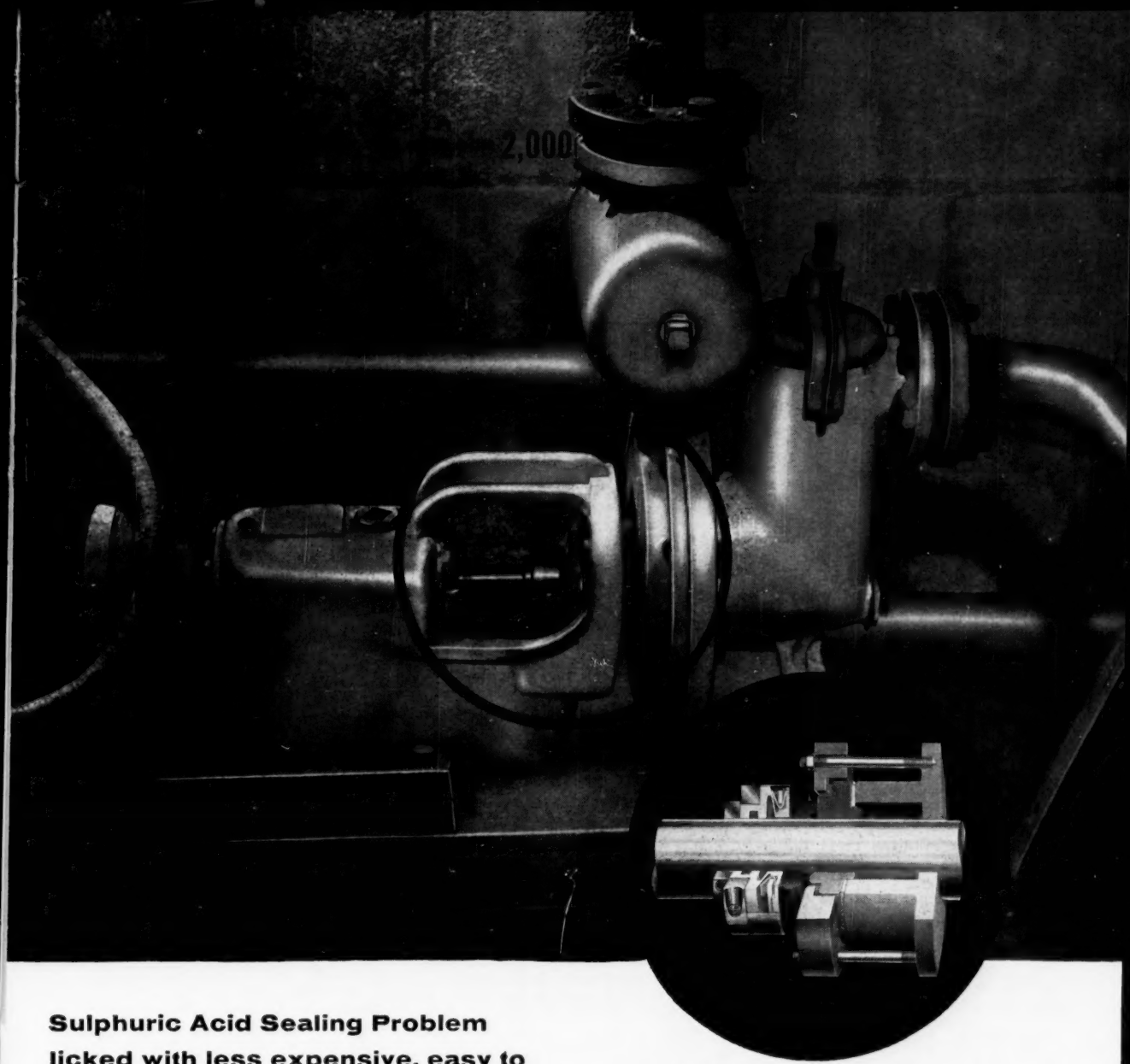
Remember that this versatile condenser tube is available in a wide range of sizes, types and alloys in copper, aluminum and electric welded steel. It is also available in low fin form (Type S/T) for shell and tube applications and with high fins (Types H/A, H/R, L/C, I/L) for air cooled operations.

- **Asphalt heater**
- **Reboiler**
- **Atmospheric section**
- **Light hydrocarbon condensing**
- **After coolers**
- **Heater**
- **Nitrogen after coolers**
- **Propane condensing**
- **Debutanizer condenser**
- **Ammonia condensing**
- **Methylchloride condensing**
- **Phenol cooler**
- **Ethyl chloride condensing**
- **Butalene condensing**
- **Freon condensing**
- **Toluene reboiler**
- **Iso Butane condensing**
- **Coolers**
- **Oil to Oil**
- **Steam to steam**
- **Oil coolers**
- **Gas coolers**
- **Inter-cooler**
- **Kero-coolers**
- **Oil heater**
- **Tank suction heaters**
- **Stripper overhead condenser**
- **Amine reboiler**
- **Debutanizer bottoms cooler**
- **Alcohol cooler**
- **Lube oil cooler**
- **Lean oil-rich oil exchanger**

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Manufacturers of Quality-Controlled Tubing and Extruded Aluminum Shapes

PLANTS IN DETROIT, MICHIGAN, AND DECATUR, ALABAMA.
SALES OFFICES IN PRINCIPAL CITIES
EXPORT DEPARTMENT, 13 EAST 40TH STREET, NEW YORK 16, NEW YORK
Wolverine Trufin is available in Canada through the Unifin Tube Co., London, Ontario.



Garlock CHEMISEAL Mechanical Seal used on pumps at Continental Oil Co. has TEFLON bellows, a TEFLON-filled carbon sealing face, and ceramic stationary seat.

Sulphuric Acid Sealing Problem licked with less expensive, easy to install *Garlock Mechanical Seal*

In April 1955, Continental Oil Co., Chicago installed a standard Garlock CHEMISEAL* on a centrifugal pump handling 101.6% and 78-80% sulfuric acid for one-fourth the cost of the previous seal. This outside seal was reported easy to install by regular maintenance personnel. The service life is 8 to 10 months compared to 8 days for soft packing.

Now all centrifugal pumps in this service at Continental are equipped with Garlock CHEMISEAL Mechanical Seals. They handle up to 100,000 lbs. per day of sulfuric acid at temperatures to 135° F.

Garlock CHEMISEALS can solve your difficult sealing jobs too. Ask your Garlock representative for his recommendation. He can choose from "The Garlock 2,000" . . . two thousand different styles of packings, gaskets, and seals for every need. Or write for CHEMISEAL Folder AD-164.

*Registered Trademark

THE GARLOCK PACKING COMPANY, Palmyra, New York

For Prompt Service, contact one of our 30 sales offices and warehouses throughout the U. S. and Canada.

GARLOCK

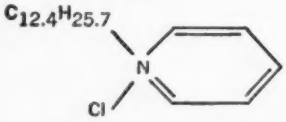
Packings, Gaskets, Oil Seals, Mechanical Seals, Molded and Extruded Rubber, Plastic Products

BRIEFS for buyers of

Detergents, Germicides
Aromatic Chlorides
Caustic Soda

This detergent kills germs

You may be missing something big if you haven't looked lately at the properties of *lauryl pyridinium chloride.*



We produce this as a technical-grade mottled tan semi-solid, containing 85.0% min. alkyl pyridinium chloride calculated as C_{12}. It is greasy or soapy to the touch, and lathers freely in water.

Surface tension of a freshly prepared aqueous 0.01% solution at 25° C is 55 dynes/cm; of a 0.1% solution, 45 dynes/cm; of a 0.5% solution, 33 dynes/cm. The surface tension of dilute solutions becomes even lower during aging.

In aqueous solutions more dilute than .01N, the solute is molecularly dispersed. In stronger dispersions, the lauryl pyridinium cations are aggregated into colloidal micelles, but the solutions look clear to the naked eye.

Indications are that, like other quaternary ammonium compounds, lauryl pyridinium chloride has good germicidal properties. It is a potent bactericide against gram-positive and gram-negative microorganisms.

Where can you use it? At present, a major use is in wetting and lubricating the tiny spinnerette holes through which viscose squeezes just before it becomes rayon.

Some other places where you might put it to work, if your field of interest is:

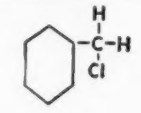
Textiles—for cleaning fibers; in water-soluble lubricants; as wetting agents, color modifiers.

Pharmaceuticals—as industrial germicides; in disinfectants, preservatives; antiseptic soaps.

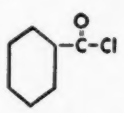
Agriculture—in insecticides, fungicides, horticultural sprays.

Elsewhere—intermediate for foam-resistant compounds; general cationic emulsifying, dispersing and wetting agent; photosensitivity modifying agent; leveling agent in polishes and waxes; lubricant for preparation of hydrophobic surfaces to promote drop-wise condensation.

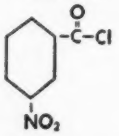
As an exploratory starting point, why not check the coupon for a data sheet on this product? *If you'd like an evaluation sample, please write us on your business letterhead.*



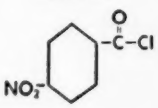
Benzyl Chloride



Benzoyl Chloride



m -Nitrobenzoyl Chloride



p-Nitrobenzoyl Chloride

Four versatile aromatic chlorides

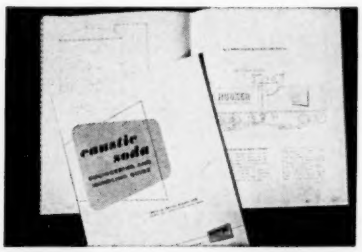
These Hooker aromatic compounds give you easy, practical ways of putting benzyl, benzoyl, and nitrobenzoyl groups into organic compounds, particularly through Friedel-Crafts reactions.

Each of these compounds will undergo other reactions to produce a variety of useful products.

All four compounds are high-quality chemicals. On two of them—*meta-* and *para-*nitrobenzoyl chloride—Hooker is the only brand available in commercial quantities.

You can order as little as a 5-gallon container of these compounds, or as much as a carload.

If you'd like to know more about the specifications and physical and chemical properties of these compounds, check the coupon for technical data sheets.



40-page manual tells how to handle caustic soda

Written for engineers, this 40-page Hooker manual sums up newest techniques for handling and storage of liquid caustic soda.

Contents include detailed diagrams of equipment; a section on materials of construction; recommendations for unloading, diluting, piping, and storage; and a section on safety precautions and first aid.

For a copy, check the coupon for Hooker Bulletin 102, *Caustic Soda Engineering and Handling Guide.*

For more information on chemicals mentioned on this page, check here:

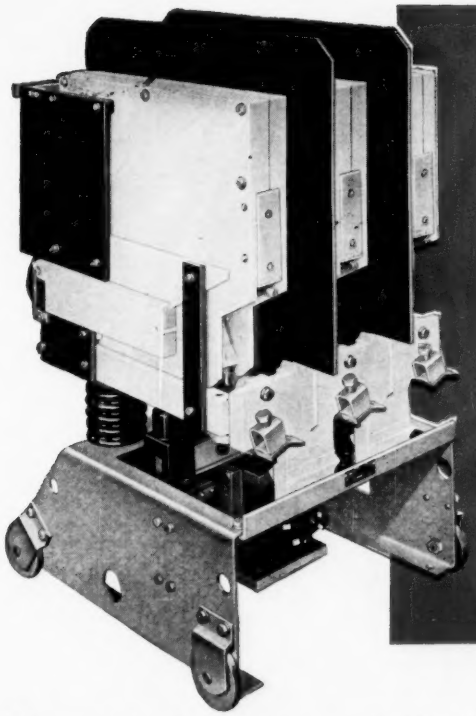
- ☐ Lauryl Pyridinium Chloride
- ☐ Benzyl Chloride
- ☐ Benzoyl Chloride
- ☐ m-Nitrobenzoyl Chloride
- ☐ p-Nitrobenzoyl Chloride
- ☐ Caustic Soda
- ☐ Caustic Soda Engineering and Handling Guide, Bulletin 102

Clip and mail to us with your name, title, and company address. (*When requesting samples, please use business letterhead.*)

HOOKER ELECTROCHEMICAL COMPANY
404 FORTY-SEVENTH STREET, NIAGARA FALLS, N. Y.

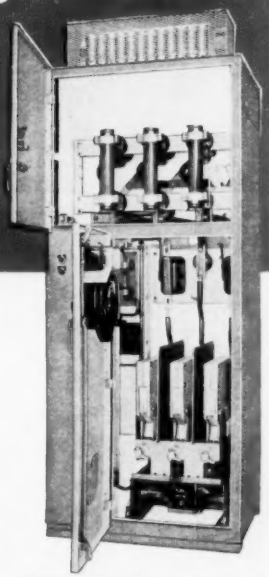
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HOOKER CHEMICALS PLASTICS



Air break starters
for high voltage motors

A-B QUALITY



This *new* air break contactor—around which Allen-Bradley has developed a complete line of high voltage starters—is designed to match your *toughest* applications. It features the same solenoid design—with only *one* moving part—that has made Allen-Bradley low voltage starters universally recognized for their tremendous operating life.

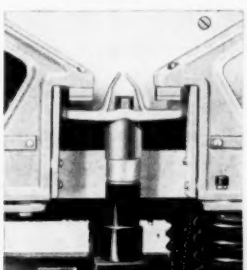
These new contactors are available in full voltage and reduced voltage starters—nonreversing or reversing—for squirrel cage, part winding, slip ring, and synchronous motors up to 1500 hp, 2300 volts; 2500 hp, 4600 volts. All starters are equipped with current limiting fuses and have an interrupting capacity of 150,000 kva at 2300 volts and 250,000 kva at 4600 volts.

It will pay you to investigate these *quality* starters. Complete information is contained in Publication 6080 . . . please send for your copy, today.

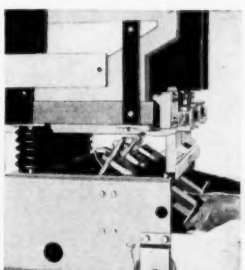
Bulletin 966 high voltage air break, across-the-line synchronous motor starter in NEMA Type 1 enclosure.



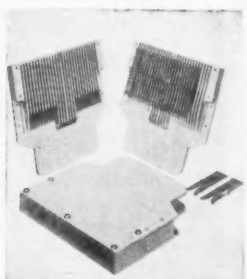
Only One Moving Part. Simple solenoid design eliminates trouble-causing pins, pivots, and flexible jumpers.



Double Break Contacts of silver alloy never need maintenance. Vertical motion assures uniform contact pressures.



Easy Access from Front. Crossbar and contacts removable from front, without special tools, for easy inspection.



Faster Arc Suppression. New blowout design and novel arc chute. Chutes are molded from an arc resistant material.

Allen-Bradley Co.
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ALLEN-BRADLEY
MOTOR CONTROL
QUALITY

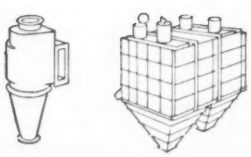


Buell Precipitator at mid-western cement plant.

Specialists in treatments for the flue

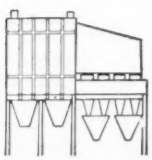
Hundreds of installations have proved the extra efficiency of Buell Dust Collection Systems. In mechanical collectors, only Buell cyclones have the exclusive Shave-off that traps an extra percentage of dust, large-diameter design that eliminates bridging and clogging. In electrical collectors, only Buell "SF" precipitators have features like high-emission, failure-proof Spiralectrodes. The results are high collection efficiency, freedom from shut-downs, minimum or no maintenance year after year in every Buell installation. Get the full story in "The Collection and Recovery of Industrial Dusts." Write Dept. **12-D,** Buell Engineering Company, Inc., 123 William Street, New York 38, New York.





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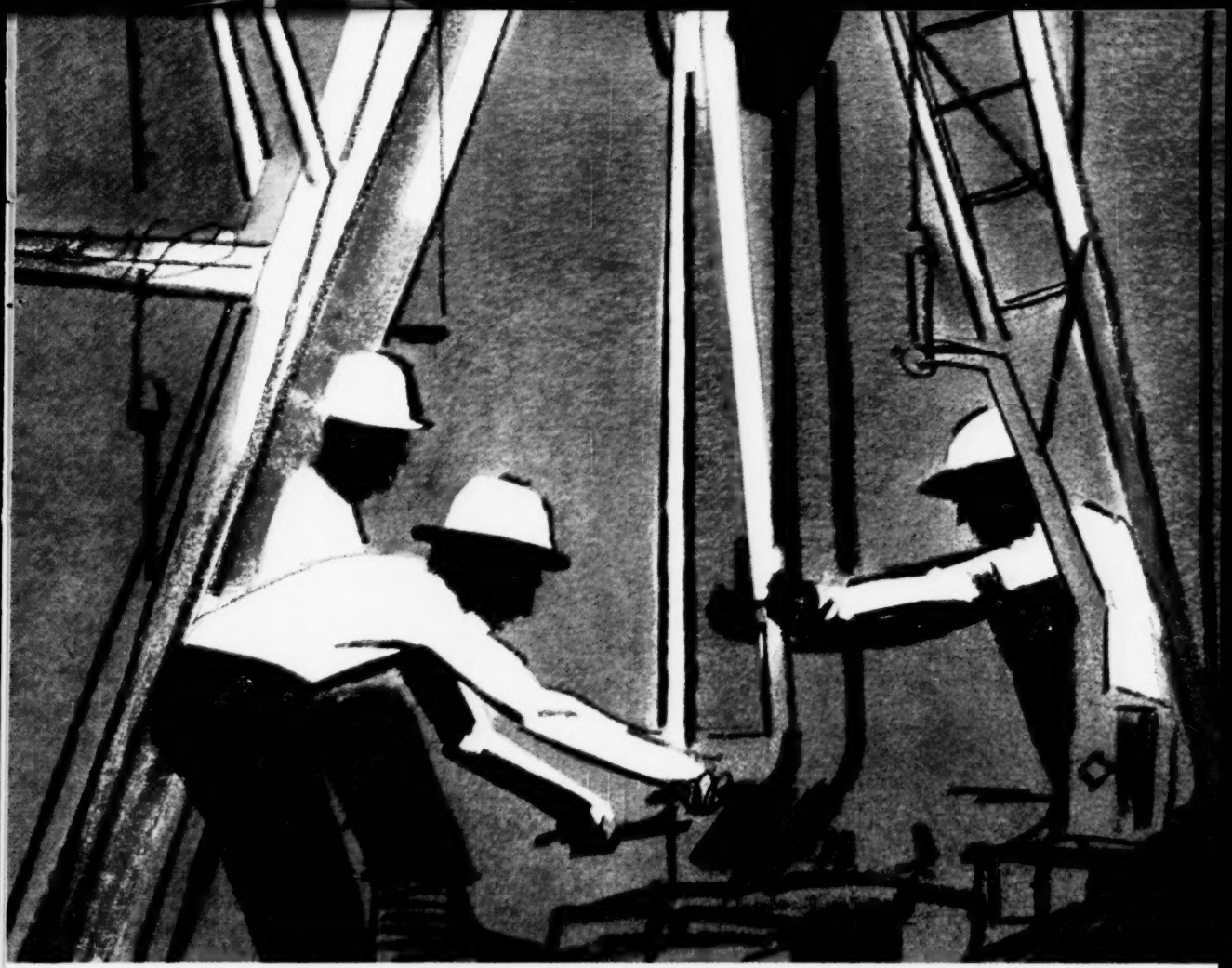
"SF" ELECTRIC PRECIPITATORS



PRECIPITATOR-CYCLONE COMBINATION

buell®

Experts at delivering Extra Efficiency in **DUST COLLECTION SYSTEMS**



Sign of Water....Layne

Vital to all chemical operations is a guaranteed supply of water. Water for removing heat loads, process consumption and accompanying plant operations—all require determined amounts for an hour, a day, a year—indefinitely. That's why the well site must be accurately determined and the well constructed to deliver the available water.

Layne wells circle the globe. Every condition and every problem possible has been met and solved. This know-how and over three quarters of a century of experience result in efficient, economical wells—the basis of many industrial water systems. Layne drilled wells provide a reliable water source—the criterion for industrial water supply.

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LAYNE ASSOCIATE COMPANIES THROUGHOUT THE WORLD



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WATER TREATMENT

TO: LAYNE & BOWLER, INC.
MEMPHIS 8, TENN.

Gentlemen: Please send me bulletin No. 100

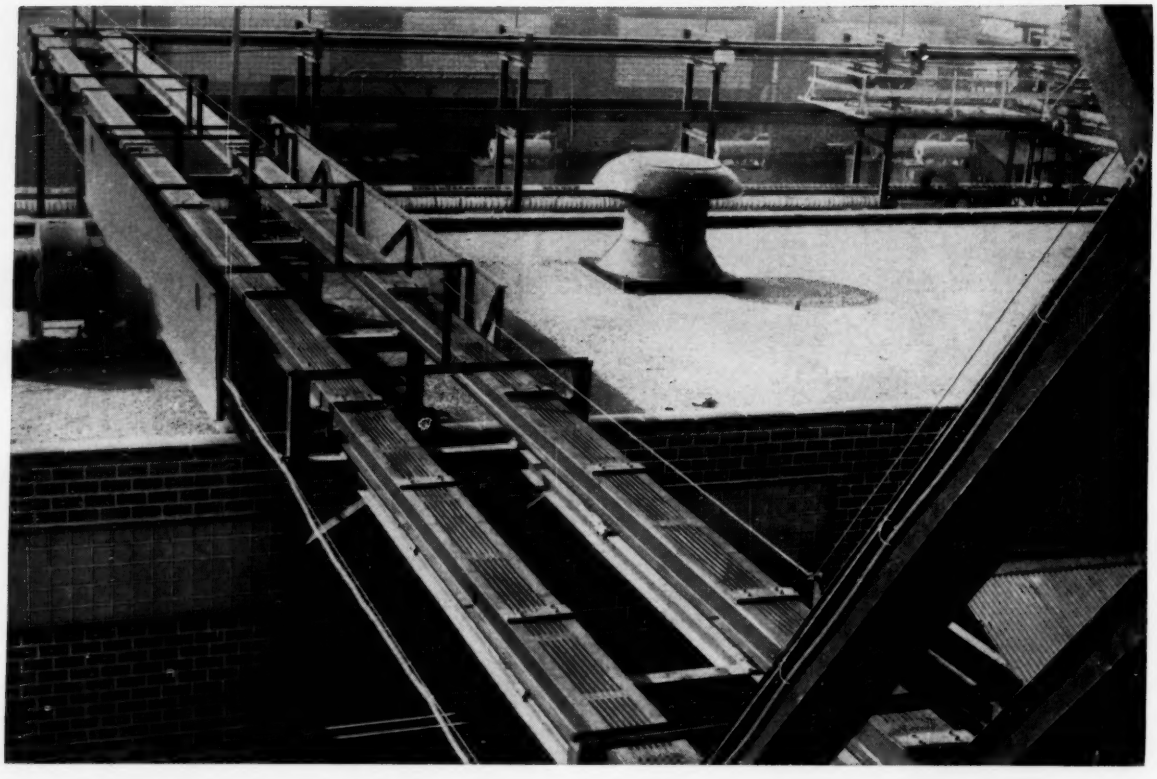
*NAME*_____

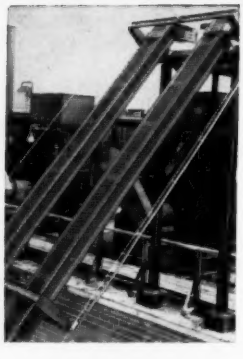
*TITLE*_____

*ORGANIZATION*_____

*ADDRESS*_____

*CITY*_____ *STATE*_____





▲ Insulators are installed at bottom and sides to support the bus and brace against short circuit forces.

◀ Sloping aluminum bus is unsupported between buildings of different heights. Steel frames provide rigidity.

Alcoa Aluminum Bus Serving Ethyl's Sodium-Chlorine Plant

To transmit 30,000 dc amperes at 550 volts from one rectifier station to another, at a circuit distance of 700 feet, Ethyl Corporation engineers weighed the facts, then chose lightweight, corrosion-resistant aluminum bus conductors. In considering conductors, they found three big advantages with aluminum: it cost less per foot of conductor; weighed about 50% less than copper of the same current-carrying capacity; and, as a result of this lighter weight, also reduced the cost of supporting structures for the system.

This is the second aluminum bus conductor installation by Ethyl. The performance of the first, as well as its economy, led to this second installation. The bus system serves sodium-chlorine electrolytic cells. The natural oxide film on the aluminum protects the bus from further corrosion. This protective film also improves the heat-radiating characteristics of the bus, permitting cooler operation or additional load-carrying capacity.

Savings also appeared during installation. Shielded arc consumable electrode welding, because of its flexibility and speed, was used for the welded joints. Most of the welding was done on the ground where the supporting beams were assembled, facilitating installation and increased safety.

As in many industries, the electrochemical industry has found that bus systems of Alcoa® Aluminum are the modern answer to the need for economical power distribution. For complete information about Alcoa Bus Conductors, consult your local Alcoa distributor or sales office, or write to Aluminum Company of America, 2304-D Alcoa Building, Pittsburgh 19, Pennsylvania.

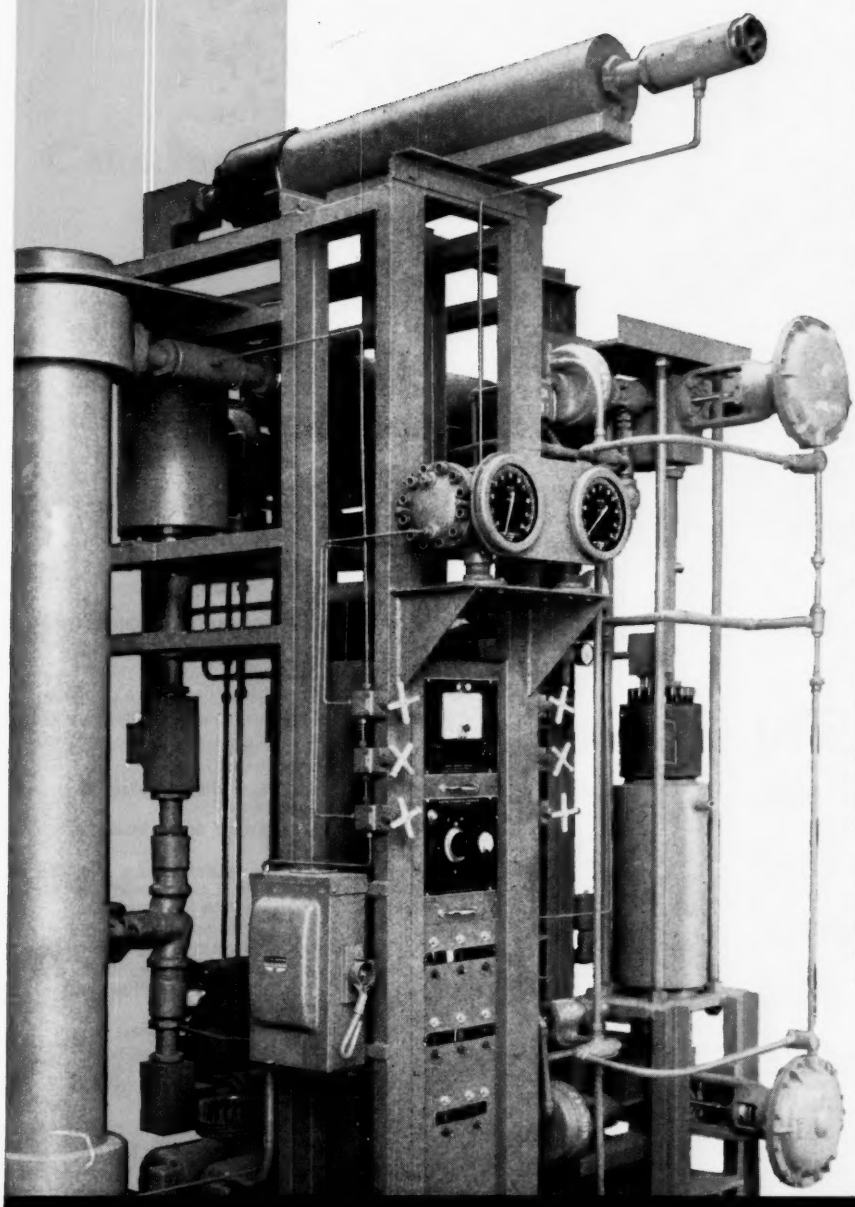
ALCOA ALUMINUM
ELECTRICAL CONDUCTORS AND ACCESSORIES
ALUMINUM COMPANY OF AMERICA

Your Guide to the Best in Aluminum Value

"ALCOA THEATRE"
Exciting Adventure
Alternate Monday Evenings

High-Pressure GAS DRIER

Cleans and dries air, helium, nitrogen and other gases under high pressure . . .



Recently installed at one of the nation's largest missile test facilities, the Aminco High Pressure Gas Drier (illustrated) has a gas input capacity of 15,000 standard cu. ft. per hour at 6000 psi. The unit dries gas and removes hydrocarbon vapors to five parts per million; it delivers gas having a dryness down to dew points of minus 100 or better.

Driers are of conventional dual desiccant design (one vessel dries while the other is being reactivated). Drying and reactivation cycles are controlled automatically by means of program timers. The humidity content of the outlet gas is monitored by an Aminco Electric Hygrometer System which operates on the principle that a change in the electrical resistance of a hygroscopic medium will occur with any change in humidity.

The electrical circuit is so designed that in the event of high-humidity output, the electric hygrometer system will automatically over-ride the timer system and control drier functions.

All major components of the drier are machined from stainless steel forgings. All vessels have full-opening closures to facilitate removal of desiccants and internal elements. Aminco self-engaging high pressure pipe joints are used throughout.

AMINCO HIGH PRESSURE GAS DRIERS CAN BE CONSTRUCTED TO MEET ANY INDUSTRIAL OR MILITARY REQUIREMENT FOR THE DRYING AND CLEANING OF GASES AT ELEVATED PRESSURES.

For additional information—

Write for catalog 407-C

AMERICAN INSTRUMENT CO., INC. 8030 Georgia Avenue, Silver Spring, Maryland



UNITRON

the most forward achievement yet in semi-conductor rectification

Developed in the engineering laboratories of I-T-E. Tailored to meet the particular needs of the electrochemical industry. Now this new semi-conductor rectifier offers you a combination of advantages not available from any other source.

1. Can be used in parallel with any other type of conversion equipment
2. Forced equalization of inverse voltage across series-connected cells
3. Forced equalization of current between parallel-connected cells
4. Cells individually isolated in case of fault, whether connected in series or parallel or both, by current-limiting Amp-Trap ultra-high-speed fuses
5. Closed system water cooling—you can change damaged cells without disturbing the cooling system
6. Ion-exchange water purifier to maintain high purity of cooling water and thus prevent corroding and electrolizing
7. Available in any desired d-c voltage and current rating

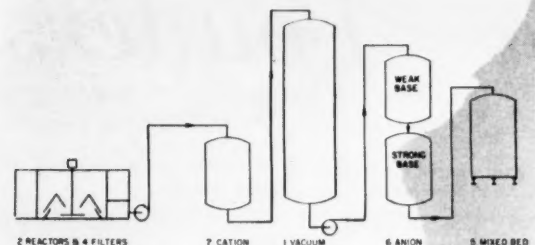
The first new I-T-E UNITRON Semi-Conductor Rectifier has recently been installed, delivering 10,000 amp at 300 v. Other units are scheduled for early installation. Write for technical information. I-T-E Circuit Breaker Company, Transformer & Rectifier Division, 19th & Hamilton Sts., Philadelphia 30, Pa.

I-T-E

I-T-E CIRCUIT BREAKER COMPANY

PHILADELPHIA, PENNSYLVANIA

LEADERSHIP IN WATER CONDITIONING



FLOW DIAGRAM 4 BED SYSTEM WITH MIXED BED POLISHING SECONDARY UNITS — Q = 3200 GPM

LINDEN

Cochrane DEMINERALIZER

protects high pressure boilers and turbines at Linden Generating Station

WATER ANALYSIS In Parts Per Million

	Raw Water	Final Effluent	
Turbidity	3-46	0 to 0.5	Primary Treatment
Color	40-160	0 to 2	
Total Hardness as $CaCO_3$	26-164	0	Demineralizer
Alkalinity as $CaCO_3$	66-183	0 to 0.1	
Silica as SiO_2	3-12	0 to 0.01	
Dissolved Oxygen as O_2	Saturated	0 to 0.1	
Total Dissolved Solids	100-520	0 to 0.2	

TREATING PLANT

- 2—Solids-Contact Reactors, 62' dia. x 18' high, with four peripheral gravity anthracite filters. — Primary Treatment
- 7—Cation Units, 12' dia.
- 1—14' Vacuum Deaerator, rubber-lined.
- 6—Weak Base Anion Units, 12' dia.
- 6—Strong Base Anion Units, 12' dia.
- 5—Mixed-bed Polishing Units, 12' dia. — Demineralizer

Public Service Electric and Gas Company's new Linden Generating Station features the most outstanding Demineralizer Plant ever installed. The system, designed and manufactured by Cochrane, treats 30 to 100% make-up for boilers with design pressures up to 2700 psig.

Some of the unique features include complete automatic remote control for both primary treatment and Demineralizer Plant . . . Filter and demineralizer backwash recovery for re-use . . . Re-use of most anion rinse water . . . Low acid consumption . . . Silica reduction in two stages: first, by strong base primary anion units, then by mixed bed secondary units . . . Low caustic soda requirements . . . Resins cleaned by brine automatically. These and many other features assure the ultimate in efficiency for this plant.

Cochrane's years of experience in the design and manufacture of every type of water treating equipment are your assurance of continuing satisfactory performance.

COCHRANE CORPORATION WATER CONDITIONING ENGINEERS SINCE 1863 PHILADELPHIA

Cochrane
CORPORATION
3113 N. 17TH STREET, PHILADELPHIA 32, PENNA.
NEW YORK • PHILADELPHIA • CHICAGO

Cochrane Water Conditioning Ltd., Toronto 4; Montreal 1; Winnipeg 1
Representatives in 30 principal cities in U.S.: also Havana, Cuba; San Juan, Puerto Rico; Paris, France; LaSpezia, Italy; Mexico City, Mexico; Caracas, Venezuela; Santiago, Chile; Honolulu, Hawaii; Manila, Philippine Islands.
Pollstown Metal Prods. Div.—Custom built carbon steel and alloy products.

Demineralizers • Zeolite Softeners • Hot Process Softeners • Hot Lime Zeolite Softeners • Dealkalizers • Reactors • Deaerators • Pressure Filters
Continuous Blowoff Systems • Condensate Return Systems • Steam Specialties

SPROUT-WALDRON

Pointers

for Mixing and Blending • Size Reduction
Size Classification • Bulk Materials Handling • Pelleting and Densifying

Published in the interest of better processing by Sprout, Waldron & Co., Inc., Muncy, Penna.

VERTICAL MIXERS NEW SOURCE FOR AGITATED STORAGE

Faced with the problem of maintaining batch uniformity, a prominent manufacturer found the solution in a battery of four 150 foot Vertical Mixers which serve as reservoirs.

Stock emerging from the dryer is first passed through a disintegrating mill which breaks up any compacted lumps. The mill is fitted with properly vented surge hopper and a horizontal screw leading to each Vertical Mixer. In these mixers successive batches of die stuffs are thoroughly distributed among several preceding batches to assure continuous uniformity of the finished product.

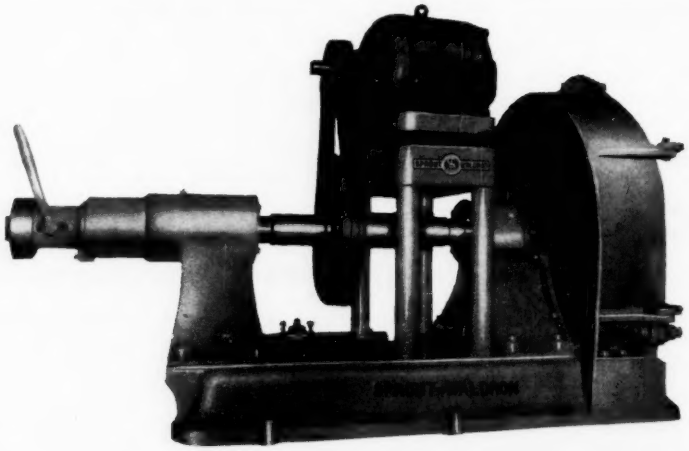
For simplification, a single color is assigned to each mixer. This completely eliminates color contamination and frequent cleaning.

The Adaptioneered® Sprout-Waldron Vertical Mixers have to be dust-proof due to the fine character of the material. Each unit requires approximately 25 square feet of floor space and only 5 to 7 horsepower. The use of Vertical Mixers for agitated storage is a new twist, but a good one.

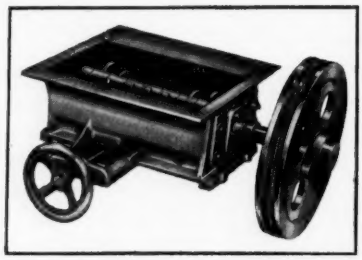
— SW —



Self-loading Sprout-Waldron Bulk Trucks cut handling and delivery of dry materials in the process industry.



Adaptioneered® Attrition Mill Puts Spring in Cork



To give cork the resiliency it needs to preserve the fizz in soda, the compression in your engine or the spring in your linoleum, it must be free of the hard pieces of bark that adhere so tenaciously. To remove this hard bark the granules were subjected to severe rubbing and squeezing on burr stone mills. Not only is this a slow process, with capacities approximately 750 pounds per hour, but dressing burr stones is a laborious and costly job requiring a special skill that is fast disappearing.

Adaptioneered® S-W Swinghead Single Disc Attrition Mills are now doing the job at twice the speed and for less money. In these mills the cork granules are rubbed and squeezed between two abrasive stone discs, one revolving and one stationary. The attrition mills are equipped with specially developed artificial stones available for a fractional cost of the original. Hand dressing is eliminated. Adaptioneering® saves this customer thousands of dollars annually in maintenance.

CP/102

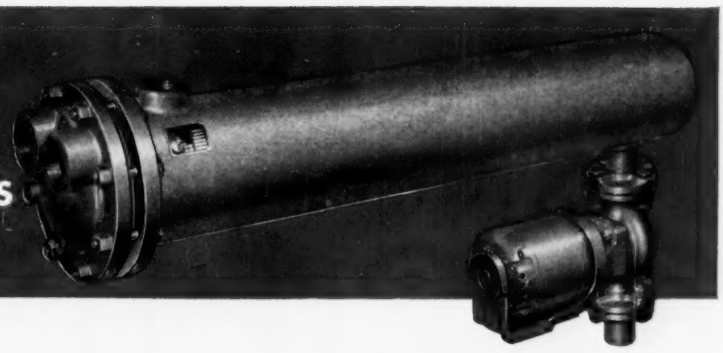
BLOOD BOTTLES BUSTED

To avoid the risk of reusing unsterilized glass bottles used for the shipment of process blood, it was decided to destroy them by crushing in an Adaptioneered® Sprout-Waldron Single Roll Crusher.

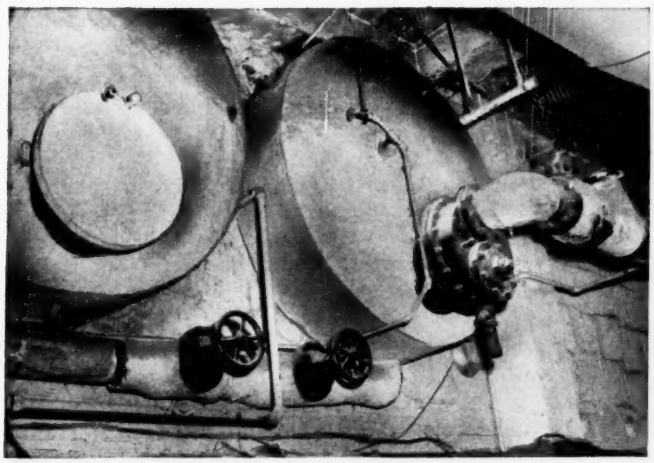
Heavy duty glass bottles, the largest size being 3½″ in diameter and 6″ deep, are reduced to approximately ½″ ring size at the rate of 1,000 a day, by an 18″ Single Roll Crusher requiring only 12″ working head room and only 5 horsepower. Bulletin No. 116-A tells the up-to-date story on S-W Single Roll Crushers. Copies available on request.

B&G®

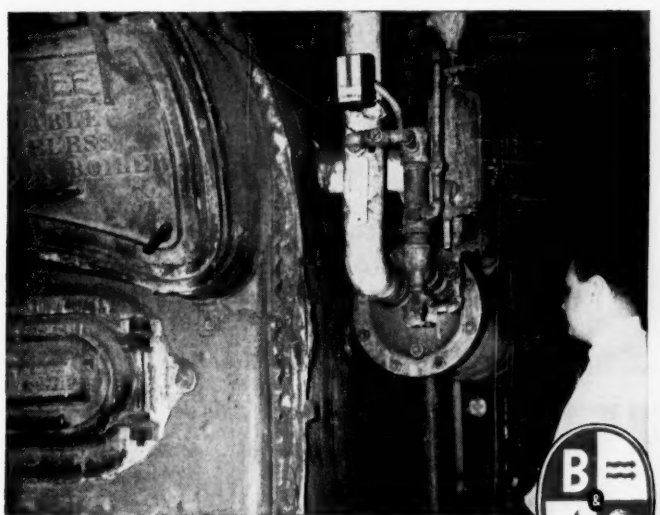
"WU" INSTANTANEOUS WATER HEATER



SAVES REPLACING EXPENSIVE HOT WATER STORAGE TANKS



THE PROBLEM: *How to economically replace two leaking hot water tanks.*



THE SOLUTION: *Old tanks were capped off and a compact B&G Type "WU" Instantaneous Water Heater connected to the boiler.*

The photos here tell a significant story to plant superintendents and operating engineers. The "Problem" picture shows two old-fashioned hot water storage tanks, requiring replacement because of leakage... the "Solution" picture how the tanks were replaced with a modern B&G Instantaneous "WU" Heater.

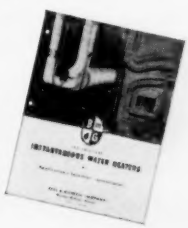
To remove and replace the two leaking hot water tanks would have been a difficult and costly job. Installing a comparatively tiny B&G Type "WU" Heater *saved hundreds of dollars* and in addition *increased the available volume of hot water!* In 12 years of operation there has never been a shortage of hot water.

Why the B&G "WU" Heater saves space and money

The "WU" comes equipped with a B&G Booster Pump which pumps boiler water through the shell, greatly increasing the capacity of the heater. Large volumes of hot water are produced by amazingly small units.

The Booster is controlled to start whenever water temperature goes below the desired degree. Boiler water is pumped through the shell of the "WU" until service water is again at the correct temperature.

The "WU" Heater can be installed on hot water boilers or below the water line of steam boilers.



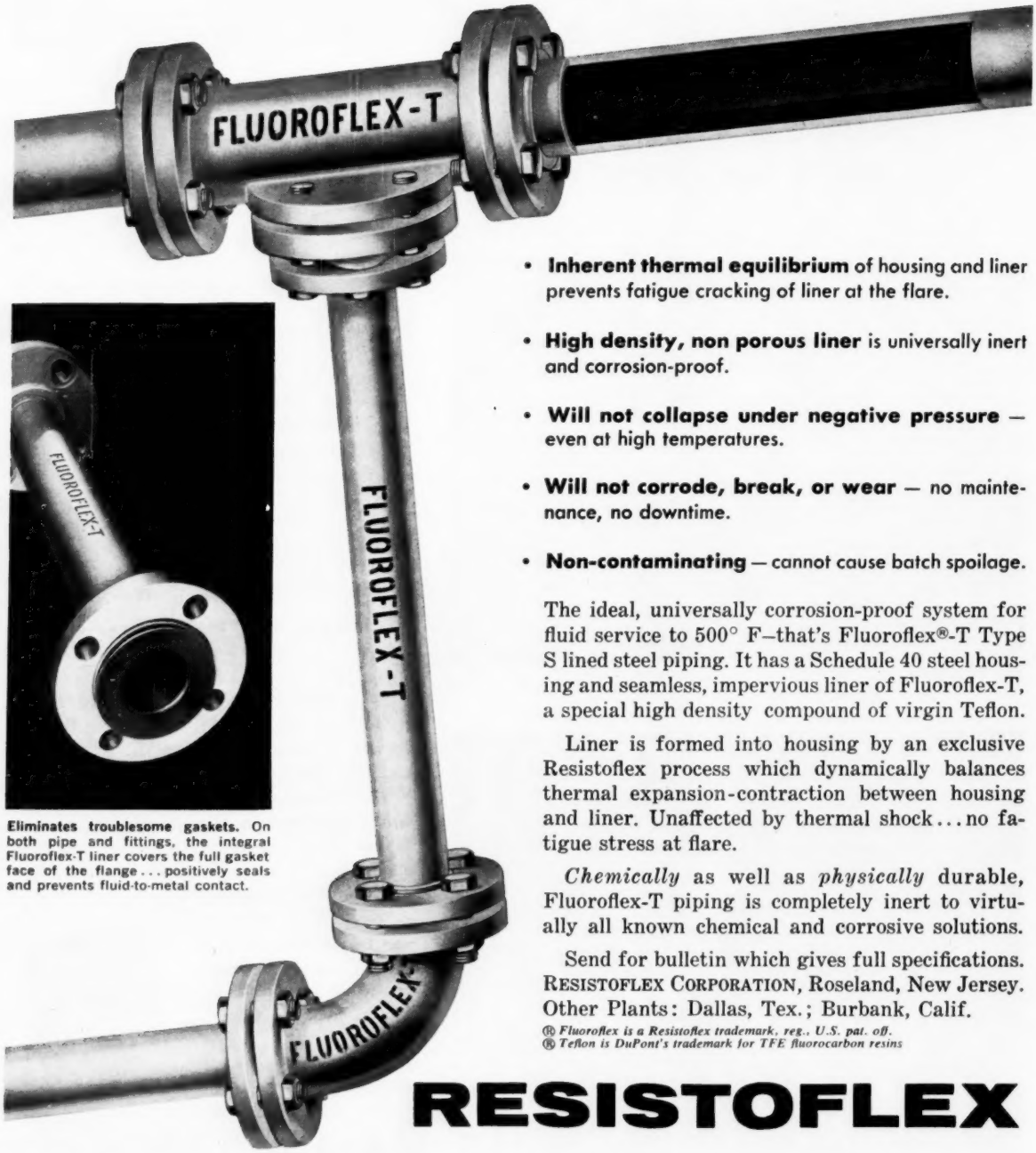
Send for this booklet on the application, selection and installation of B&G Instantaneous Water Heaters.

BELL & GOSSETT
COMPANY
Dept. FF-14, Morton Grove, Illinois
Canadian Licensee: S. A. Armstrong, Ltd., 1400 O'Connor Drive, Toronto 16, Ontario

*Reg. U.S. Pat. Off.

Piping made permanent

...with Teflon® at its best



Eliminates troublesome gaskets. On both pipe and fittings, the integral Fluoroflex-T liner covers the full gasket face of the flange... positively seals and prevents fluid-to-metal contact.

- **Inherent thermal equilibrium** of housing and liner prevents fatigue cracking of liner at the flare.
- **High density, non porous liner** is universally inert and corrosion-proof.
- **Will not collapse under negative pressure** — even at high temperatures.
- **Will not corrode, break, or wear** — no maintenance, no downtime.
- **Non-contaminating** — cannot cause batch spoilage.

The ideal, universally corrosion-proof system for fluid service to 500° F—that's Fluoroflex®-T Type S lined steel piping. It has a Schedule 40 steel housing and seamless, impervious liner of Fluoroflex-T, a special high density compound of virgin Teflon.

Liner is formed into housing by an exclusive Resistoflex process which dynamically balances thermal expansion-contraction between housing and liner. Unaffected by thermal shock... no fatigue stress at flare.

Chemically as well as *physically* durable, Fluoroflex-T piping is completely inert to virtually all known chemical and corrosive solutions.

Send for bulletin which gives full specifications. RESISTOFLEX CORPORATION, Roseland, New Jersey. Other Plants: Dallas, Tex.; Burbank, Calif.

® Fluoroflex is a Resistoflex trademark, reg., U.S. pat. off.
® Teflon is DuPont's trademark for TFE fluorocarbon resins

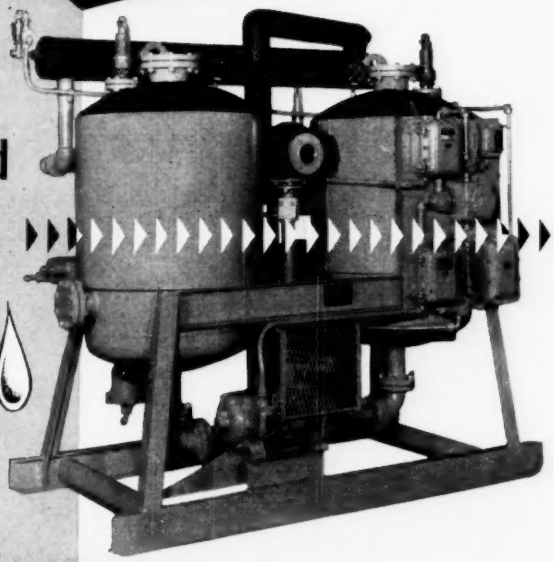
RESISTOFLEX

Complete systems for corrosive service



LINED STEEL PIPE • FLANGED FLEXIBLE HOSE • BELLOWS • ELBOWS • TEES • REDUCERS • DIP PIPES & SPARGERS • LAMINATED PIPE

Remove unwanted moisture



keep processes humming by drying instrument air with Lectrodryer

COMPRESSED AIR, freed of unwanted moisture by a Lectrodryer, makes your controls more dependable. There is no water in the air lines to cause freeze-ups, or clog delicate instrument ports by forming mud or rust. As a result, processes keep humming . . . product quality is constant.

Lectrodryer engineers have many years' experience in solving DRYing problems. The Lectrodryer equipment they recommend is generously designed and constructed for the moisture-removing load anticipated. No skimping on capacity or cutting corners on materials to meet a price.

Bulletin 223B describes Lectrodryers for instrument air DRYing. For a copy or for other help, clip and mail the coupon.

Leading industries look to

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McGRAW EDISON

World's First and Foremost Manufacturer of Commercial and Industrial Adsorbent Driers

This coupon brings you DRYing help...

Pittsburgh Lectrodryer Division • McGraw-Edison Company • 303 32nd Street, Pittsburgh 30, Pennsylvania

Moisture in compressed air is causing trouble.

☐ Send us Bulletin 223B. ☐ Have your representative call.

NAME _____ TITLE _____

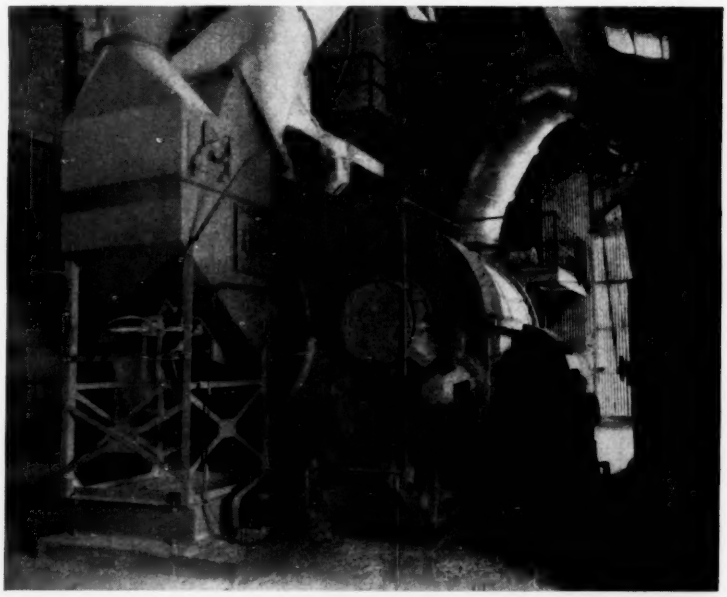
COMPANY _____

ADDRESS _____

CITY _____ STATE _____

LOWER
production costs with a
KENNEDY
air swept grinding system

The KENNEDY Air Swept Tube Mill Grinding System is the ultimate in high production and low operating cost. The experience of the many owners of KENNEDY Mills has shown that the cost of this mill can be paid in a few years with the savings in maintenance and power alone!



KENNEDY 10′ x 15′ Integral Gear Drive Air Swept Ball Tube Mill and #93 Exhauster Fan in service at the American Agricultural Chemical Co., Pierce, Florida.

HERE ARE A FEW OF THE REASONS FOR THE ECONOMY AND POPULARITY OF KENNEDY PULVERIZING SYSTEMS...

REDUCED MAINTENANCE • Tramp iron and other foreign material cannot damage the system. Years of operation are assured before parts (except for grinding balls) require replacement.

CONTINUITY OF OPERATION • Lubrication and replacement of grinding media is accomplished without shutdown or interruption of production.

MINIMUM POWER • Careful design and construction and a proven pressure lubrication system insure a high mechanical efficiency.

HIGHER PRODUCTION • Single grinding units are built for capacities to 100 tons per hour. Production and fineness remain constant, month after month.

LOWER OPERATING COSTS • Dependability of equipment and reliable automatic feed control assure high production with minimum manpower.

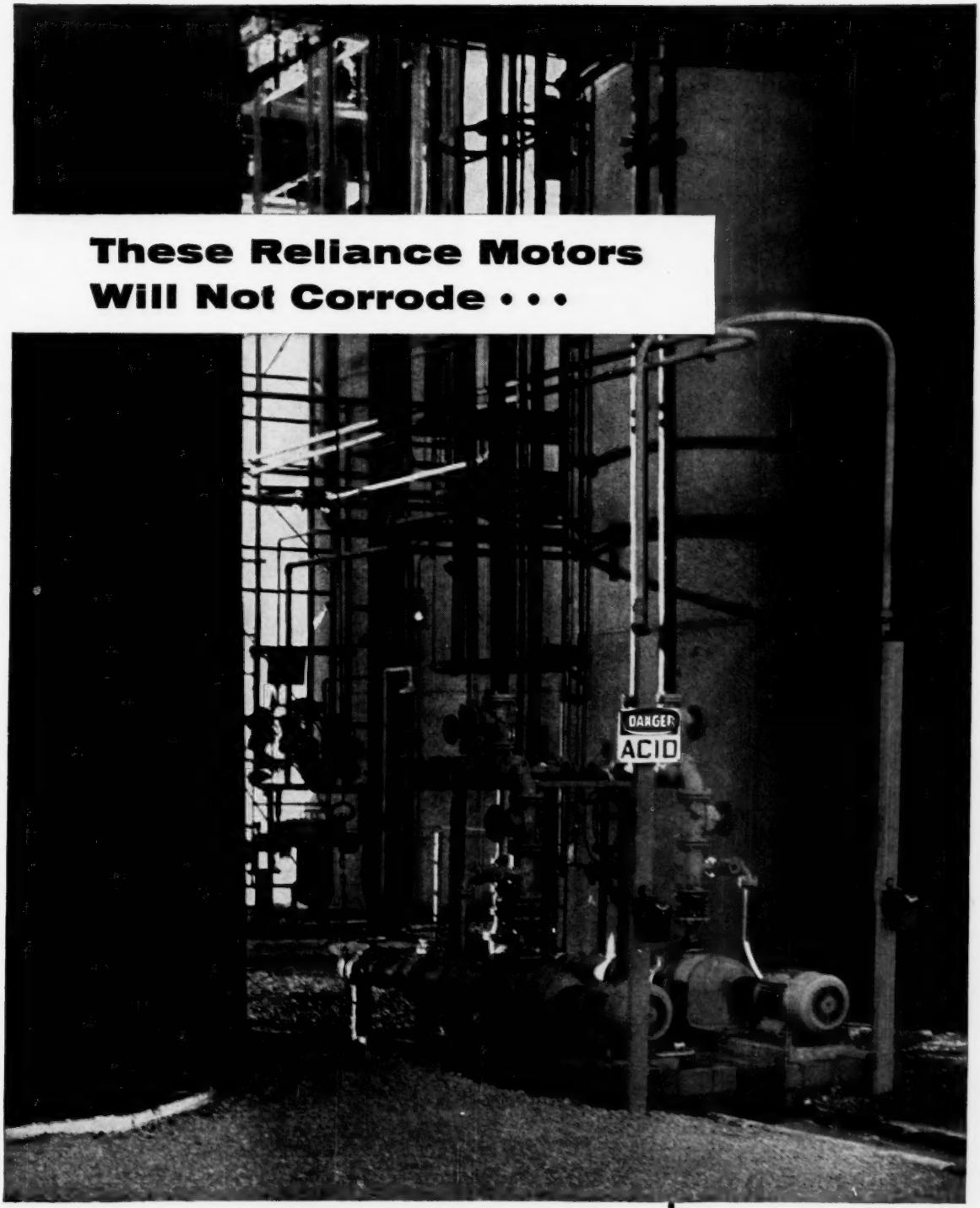
CAPITAL SAVINGS • No magnetic separators are required. KENNEDY units require less structural steel and floor space per ton of product.

FLEXIBILITY OF DESIGN • KVS Air Swept Grinding Systems are available for a wide range of capacities and products.

KVS

Send now for full details on KENNEDY Size Reduction Equipment.

KENNEDY • VAN SAUN
MANUFACTURING & ENGINEERING CORPORATION
405 PARK AVENUE, NEW YORK 22, N.Y. • FACTORY: DANVILLE, PA.



These Reliance Motors Will Not Corrode • • •

Write for bulletin B-2406 for further information on 1 to 125 hp corrosion-proof motors.

RELIANCE ELECTRIC AND ENGINEERING CO.

DEPT. 134A, CLEVELAND 17, OHIO
CANADIAN DIVISION: TORONTO, ONTARIO
Sales Offices and Distributors in Principal Cities

B-1572



"How will a Round Processor pay off?"

New Cherry-Burrell laboratory model pins down the answer before you buy!

Chances are it won't cost you any more to "test-run" your products in this 45-gallon Cherry-Burrell lab model Round Processor than it does to "test-drive" a new car. And is there any *better* way to buy?

Here's all you do: lease this Cherry-Burrell model for a nominal monthly fee . . . test your products in it . . . find out which type of heating/cooling you prefer . . . which of these four variable-speed agitators (21 to 260 r.p.m.) is "right" for your product . . . determine whether you want to process at atmospheric pressures or seal for vacuum or pressure operations.

When you find the processor "combination" that is best-by-test in handling *your* products, you apply the lab model lease fee on the purchase price of any one of five different types of Cherry-Burrell Round Processors. You can also put the fee against the price of the 45-gallon model.

For further details, see your Cherry-Burrell Representative or write for Bulletin G-545.

CHERRY-BURRELL
CORPORATION

427 W. Randolph Street, Chicago 6, Ill.

Dairy • Food • Farm • Beverage • Brewing • Chemical • Equipment and Supplies

SALES AND SERVICE IN 58 CITIES — U. S. AND CANADA

Chemical Engineering

Developments

APRIL 21, 1958

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This calcining system reaps neat savings 60

The ACL system for burning cement clinker is helping Marquette Cement Mfg. and Diamond Portland Cement save on space, dust and some 30-40% on fuel consumption.

Refinery weds low-grade crude to high-grade market ... 64

Pontiac Eastern's new refining scheme taps low-grade crude petroleum to satisfy a predominantly gasoline market. Black Creek unit yields total of 79% gasoline.

Another jet-bound rubber 72

A new fluorinated rubber, Viton, is reported to have no equal among commercial elastomers in resistance to oils, fuels and solvents at temperatures above 400 F.

CPI takes over sky-borne overheat detector 78

Designed for modern aircraft, Kidde's overheat-fire detector now helps 20 or 25 petrochemical outfits to protect synthesis gas generation facilities and personnel.

Outlook for the American economy 86

If you take the long view, things are really looking up. Despite the present siege of recession, there's every indication that the U. S. economy will double by 1975.



New **CROUSE-HINDS**
EXPLOSION-PROOF

MERCURY VAPOR

LIGHTING FIXTURES

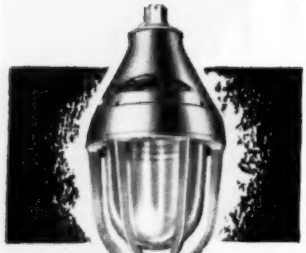
For dependable security at low operating cost in hazardous locations . . .

- *where long burning hours without interruption are involved, month in, month out*
- *where labor cost or trouble of relamping is an important factor*
- *where maximum lighting output calls for maximum economy in power consumption*

The longer life of mercury vapor lamps is well established: 7000 hours, *vs.* 1000 hours for incandescents. Light output is 2.5 times greater; 55 lumens/watt, *vs.* 22 lumens/watt for incandescents.

The new EV's place these economies within easy reach. As with all Crouse-Hinds explosion-proof devices, EV's are heavily constructed to withstand the pressure of internal explosions without rupturing. Gas-tightness is *not* a requirement for their safe performance. Flame-tight joints prevent the escape of flames to flammable atmospheres.

- *For full information, call your Crouse-Hinds distributor, or write for catalog sheet.*



TYPE EVA Explosion-Proof Lighting Fixture

Available with or without guard, or reflector (dome, deep bowl, shallow bowl, angle, or high bay)

250 Watt— National Electrical Code: Class I, Groups C & D

400 Watt— Class I, Group D

CROUSE HINDS

MAIN OFFICE AND FACTORY: SYRACUSE, NEW YORK
Crouse-Hinds Company of Canada, Ltd., Toronto, Ont.

• CONDULET® ELECTRICAL EQUIPMENT (Explosion-Proof and Conventional) • FLOODLIGHTING
• TRAFFIC CONTROL SYSTEMS • AIRPORT LIGHTING and WEATHER MEASURING EQUIPMENT

These products are sold exclusively through electrical distributors. For application engineering help, contact one of the following offices: Baton Rouge Birmingham Boston Buffalo Chicago Cincinnati Cleveland Corpus Christi Dallas Denver Detroit Houston Indianapolis Kansas City Los Angeles Milwaukee New Orleans New York Omaha Philadelphia Pittsburgh Portland, Ore. Salt Lake City St. Louis St. Paul San Francisco Seattle Tulsa Washington **Resident Representatives:** Albany Atlanta Baltimore Charlotte Chattanooga Jacksonville Reading, Pa. Richmond, Va. Shreveport

DEVELOPMENTS . . .

APRIL 21, 1958

Chementator

C. H. CHILTON

Latest chemical brainchild of Karl Ziegler to near commercialization is a process for making fatty alcohols from alpha-olefins. In Germany, Harpener Bergbau, Dortmund, has a pilot plant going; in U. S., Continental Oil is dickering with Ziegler for a license.

Now, tranquilizers for plant life: U. S. Rubber's new Durawet-20W (chemically, N-metatolyl phthalamic acid) is said to increase plant yields by reducing the effects of abnormal weather conditions.

English translations of Russian engineering and industry literature may get a boost if Commerce Dept. gets added funds. To date, attention has been disproportionately focused on the purely scientific literature.

New polyester for film and fiber

Beaunit Mills' new synthetic fiber, to be made in a $10-million, 10-million-lb./yr. plant in Puerto Rico, will be chemically the same polymer that Goodyear will produce as Videne polyester film in a new $9-million plant at Apple Grove, W. Va. (*Chem. Eng.*, Apr. 7, p. 74). Goodyear will supply polymer to Beaunit for spinning into fiber.

Composition of the new polyester hasn't been officially announced, but it apparently is based on a mixture of dimethyl terephthalate and dimethyl isophthalate. The phthalate intermediates are being supplied, initially at least, by Hercules' Burlington, N. J., plant. But Amoco Chemicals is a likely source for the long haul. Its new plant under construction at Joliet, Ill., will be favorably equipped to turn out low-cost mixed phthalates via the Scientific Design process for liquid-phase oxidation of mixed xylenes (*Chem. Eng.*, Feb. 1957, pp. 150–152).

Beaunit has been pilot-planting its new fiber at Elizabethton, Tenn. Alone or in blends, it will find its way into sweaters, underwear and other forms of apparel.

The Goodyear-Beaunit film-fiber tie-in has a close parallel in the ethylene glycol-terephthalic acid polyester produced by Du Pont, Imperial Chemical Industries and others. From the same basic polymer, Du Pont makes Dacron fiber, Mylar general-purpose film and Cronar photographic film.

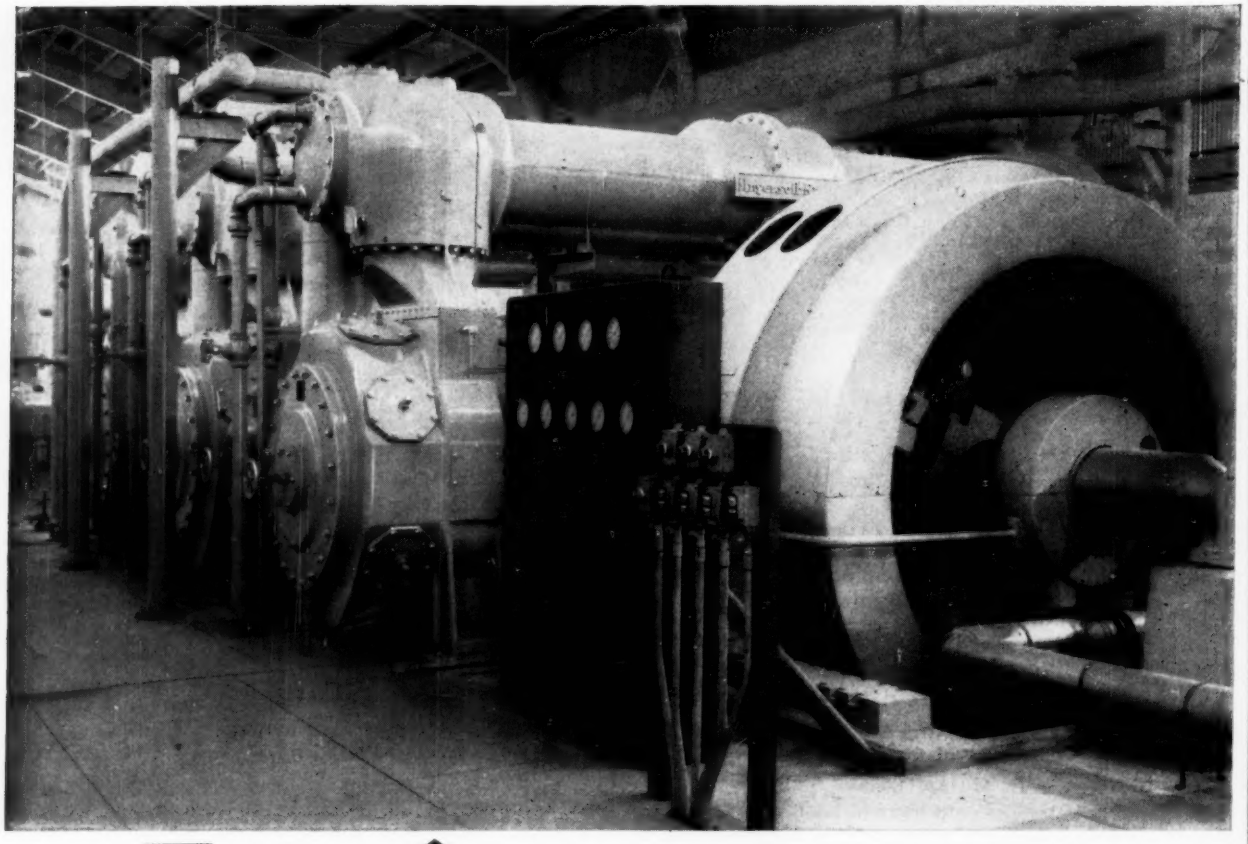
Liquid propane, methane sail the seas

Transoceanic shipment of liquefied petroleum gases will soon be a reality. While U. S. and British interests have joined in an experimental project to move liquid methane across the Atlantic, another combine reports even more ambitious plans to transport liquid propane from the Persian Gulf to Germany.

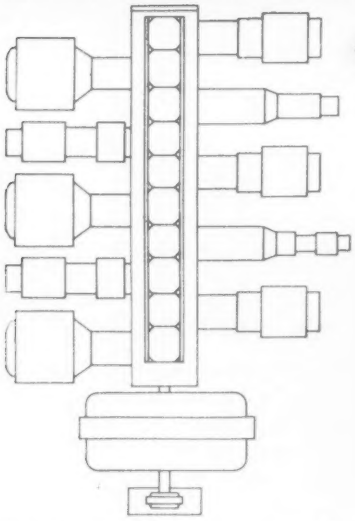
Marine Transport Lines, New York, has ordered several combination propane-oil tank-

(Continued on page 56)

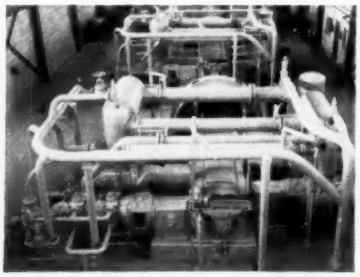
NATION'S LARGEST MOTOR-DRIVEN



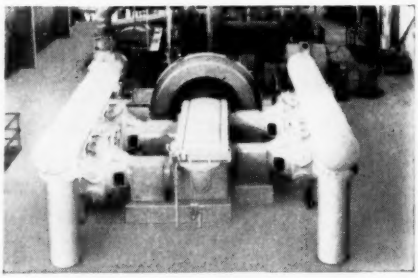
This is one of two ten-cylinder Ingersoll-Rand 6000-hp HHE compressors—the largest motor-driven reciprocating compressors in operation—on ammonia synthesis at the Geneva Works of Columbia-Geneva Steel, Geneva, Utah. Each unit simultaneously compresses coke-oven gas in two stages to 200 psi, and synthesis gas in three stages to 5300 psi. They are installed in the nation's first major steel-mill coke-oven-gas ammonia plant, engineered and constructed by Blaw Knox.



I-R design permits cylinder arrangement for best gas flow; three large cylinders handle coke oven gas in first stage, three in second stage. Others compress synthesis gas in three stages.



Above are two 2000-hp HHE's on air separation service. Each compresses oil-free air to 80 psi, and nitrogen in four stages to 2800 psi. The air cylinders are among the largest non-lubricated cylinders ever built.



This 1750-hp Ingersoll-Rand HHE compressor at the Geneva Works handles fuel gas (coke-oven gas after removal of hydrogen and carbon dioxide) for use in the steel mill. All of these HHE's are installed in the same building.

RECIPROCATING COMPRESSORS

Two 6000-hp Ingersoll-Rand units now in operation at Columbia-Geneva Steel's* NEW NITROGEN PLANT

*Division of U.S. Steel

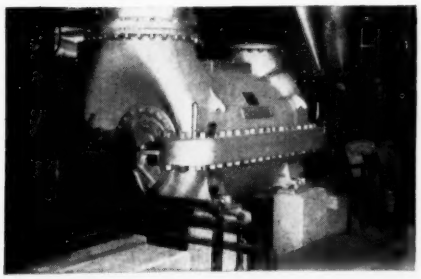
America's largest electric-driven reciprocating compressors are now at work in America's first steel-mill synthetic ammonia plant. Two ten-cylinder, 6000-hp Ingersoll-Rand HHE compressors—the first units of such size ever put into operation—are at the Geneva Works of U.S. Steel's Columbia-Geneva Steel Division in Geneva, Utah. The plant was engineered and constructed by Blaw Knox Company, and employs almost 20,000 hp of Ingersoll-Rand compressors, both reciprocating and centrifugal.

Big process jobs like this one require heavy-duty compressors that are *engineered* to the job. Compressors of this magnitude are not "off-the-shelf" items. At Ingersoll-Rand, each HHE compressor is carefully engineered from the ground up to fit the needs of its particular job.

First of all, the proper compressor cylinders are designed. They have to be of the right size, type and materials to suit the volumes, pressures and gases involved. No one can match the wide range of compressor cylinders built by Ingersoll-Rand, and the correct valving is assured by I-R's own valve design and manufacturing departments.

The cylinders must be arranged on the frame in the best sequence, and at the same time the crankshaft is *specially* designed for best running balance, smoothest torque and smoothest gas flow. These Ingersoll-Rand methods of *individual project analysis* have been proven in hundreds of process installations.

The world's most comprehensive compressor experience, in process *and* all other compressor applications, is offered by Ingersoll-Rand. Contact your I-R representative or write now for more information on HHE and other compressors for process services.



This 2800-hp I-R centrifugal compressor handles air for ammonia oxidation. The hot nitrogen from this reaction goes through an I-R expander—a power recovery turbine—which helps to drive the compressor itself.

Ingersoll-Rand

1-722

11 Broadway, New York 4, N.Y.

COMPRESSORS
VACUUM EQUIPMENT
ROCK DRILLS
GAS & DIESEL ENGINES

CONDENSERS
AIR & ELECTRIC TOOLS
PUMPS
TURBO-BLOWERS

ers, with first one scheduled for delivery next year. To be built in Italy and Germany, each 714-ft.-long ship will have six nickel steel tanks furnishing a combined capacity of about 25,000 tons of liquid propane, plus lateral tanks to carry 10,000 tons of oil.

The ships will carry cold propane at near-atmospheric pressure. Tanker cost is said to be half that of a tanker carrying LPG under pressure at ambient temperature.

Meanwhile, Constock Liquid Methane Corp.—joint subsidiary of Continental Oil and Chicago Stockyards—is fitting out at Mobile, Ala., a 5,000-ton, 339-ft.-long cargo vessel with insulated tanks for carrying liquid methane from the Louisiana Gulf Coast to the Thames Estuary. British Gas Council is putting up half the $4 million for converting the vessel, plus another $1 million to build two 1,000-ton, perlite-insulated storage tanks at its receiving terminal. Constock is building the U.S. terminal facilities, including liquefaction plant.

The five shipboard tanks (total contents: 2,100 tons) will be made of aluminum, jacketed with about 12 in. of laminated balsa wood, to carry the liquid at —260 F. and 2 psi. Constock estimates that evaporation loss will be only 0.5% during a three-week voyage.

Gas Council will vaporize the methane, adjust its Btu. value by mixing with low-Btu. gas and feed it into London's domestic gas distribution system. If economics prove to be feasible, Constock plans large-scale transport of methane from areas of surplus (e.g., Venezuela, Middle East) to other parts of the world in need of fuel energy.

Trade secrets are worth cold cash

If you go into your own business on the basis of trade secrets and know-how gained from a former employer, you may have to pay handsomely for it.

A cool half million or more will be paid by eight former employees of National Cylinder Gas who, with a ninth individual, formed Catalysts and Chemicals Inc., Louisville, last summer. NCG promptly filed suit.

Out-of-court settlement just reached provides that CCI shall pay NCG 2½% of its gross sales of all catalysts for the next seven years, with a guaranteed minimum of $500,000. If the minimum has not been paid by the end of the seven years, payments will continue until the guarantee is met.

Agreement further provides that CCI may not use the catalyst trade secrets and know-how had before Sept. 1, 1957, and that NCG shall have the option to obtain rights to catalyst developments of CCI made prior to Dec. 31, 1959, by payment of a license fee of 2½% on sales of the specific catalyst manufactured under such rights.

Silica sol boosts acid resistance

Weakest point of acidproof brick linings —the mortar between the bricks—is due for early reinforcement with new silica cements being groomed for sulfuric acid service by Pennsalt Chemicals Corp., Philadelphia.

Pennsalt's new products—tradenamed Synar—differ from conventional silicate cements in that the binder is a 30–35% aqueous colloidal silica rather than a sodium or potassium silicate solution. What gives Synar cements their unusual properties is a new setting agent discovered in Pennsalt's laboratories. The company won't identify this key ingredient now.

The setting agent is said to produce "an orderly gelation" of silica. This results in a strong mortar containing 98% SiO_2. Ordinary silicate cements, containing about 90% SiO_2, are vulnerable to sulfuric acid attack by breakdown of setting agent (a fluoride), formation of hydrated sodium sulfates or formation of potassium alums.

It's too early yet to predict useful life for Synar cements. Several large installations have been made, but the oldest—lining of a sulfuric acid concentrator—has chalked up only one year's service.

Synar cements are priced a bit higher than silicate cements. Pennsalt believes, however, that the new products will capture a big share of the market. An anticipated direct savings —in addition to longer life—is that the usual acid washing of freshly laid brickwork is unnecessary.

How to make copper ions behave

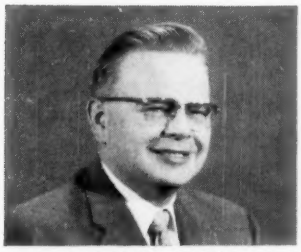
A tricky bit of electrochemistry is secret of a new process for continuously regenerating copper etching solutions used in manufacture of printed circuits.

As devised by Bell Telephone Laboratories, the new process uses an etchant of cupric

(Continued on page 58)

News from
National Carbon Company
Division of Union Carbide Corporation · 30 East 42nd Street, New York 17, N. Y.
Sales Offices: Atlanta, Chicago, Dallas, Kansas City, Los Angeles, New York, Pittsburgh, San Francisco. IN CANADA: Union Carbide Canada Limited, Toronto

National Carbon representatives expand your engineering force



L. E. BRUGMANN,
SALES ENGINEER

Mr. Brugmann was graduated from Purdue University with a B.S. Degree in Chemical Engineering. For three years he worked in the midwest as a process engineer with a large chemical company. His work covered development of new chemical processes and the improvement of existing processes, both from the technical and economical aspects of the process. It was necessary for Brugmann to know the required equipment thoroughly, to work on the design of new equipment and to draft an economic evaluation of any changes.

Mr. Brugmann has been with National Carbon Company since 1954. His first two years were spent in the Cleveland Office working up Engineering Proposals on incoming inquiries from chemical and allied industries. He has been a field engineer covering the west coast since 1956. Call your National Carbon Sales Engineer today.

"KARBATE" PUMPS HANDLE A WIDE RANGE OF CORROSIVE SERVICES EFFICIENTLY AND ECONOMICALLY



This carload of "Karbate" pumps was shipped to a major rayon producer.

During the past twenty years, "Karbate" impervious graphite pumps have gained an envious performance record corrosion wise. A recent survey on service applications indicates these pumps handle a wide variety of corrosives over a wide temperature range. Some of these solutions are: hydrochloric acid, all concentrations; phosphoric acid – up to 75%; sulphuric acid from 1 to 93%; chlorinated hydrocarbons such as benzene hexachloride, monochloracetic acid, DDT; mixed acids such as nitric-hydrofluoric, sulphuric-hydrofluoric, hydrofluoric-chromic oxide, chromic-nitric hydrofluoric, phosphoric-hydrochloric nitric; chlorinated sodium and potassium chloride brines, ferric chloride; caustic; chlorine saturated water.

The excellent corrosion resistance of "Karbate" pumps permits a given plant to utilize one type pump for all corrosive services. Such a pump standardization means a saving in pump parts inventory, and also means lower maintenance costs due to greater proficiency in handling one type pump.

"KARBATE" PUMPS FEATURE LOW MAINTENANCE COSTS

A rayon manufacturer reports using "Karbate" impervious graphite pumps to handle rayon spin bath solutions. Maintenance costs on each pump were $25.00 the first year and $25.00 the second year – costs on an alloy pump were $25.00 the first year and *$500.00 the second year.*

A major chlorine producer is using "Karbate" impervious graphite pumps to handle chlorinated cell brines. Eighteen pumps are in service. Maintenance costs on the "Karbate" pumps are approximated at $100.00 per pump per year as compared to costs on another non-metallic type pump of *$500.00 per pump per year.*

• • •

"KARBATE" PUMP TABLE OF SIZES AND CAPACITIES

Pump size Suction		Discharge	Motor-Mounted Type F	Frame-Mounted Type C
2	x	1½	29-FAL	1½-CB
3	x	2	19-FAL	2-CA 2-CB
4	x	3	—	3-CA 3-CB
6	x	4	—	4-CA

NATIONAL TRADE-MARK

The terms "National", "N" and Shield Device, "Karbate" and "Union Carbide" are registered trade-marks of Union Carbide Corporation.

UNION CARBIDE

chloride in the presence of excess chloride ions (e. g., sodium chloride), instead of the usual $FeCl_3$. Spent solution is continuously withdrawn for electrolytic regeneration.

In electrolysis, normal reaction is for cuprous ions to be oxidized to cupric at the anode and for cupric to be reduced to cuprous at the cathode, leaving no net reaction. However, Bell Labs decreases the cathode area to get higher current densities. As c.d. goes up, a point is reached where cupric ions are reduced to cuprous as fast as they reach the cathode surface. Further increase in c.d. forces immediate reduction of these cuprous ions to metallic copper. Net reaction then is oxidation of one mole of cuprous ion to cupric plus reduction of one mole of cuprous ion to copper.

Bell Labs has worked out the process on a small scale at Murray Hill, N. J., is now putting in a pilot plant at Whippany, N. J. Process will be available to printed circuit manufacturers and photoengravers on a royalty basis. Advantages of the new process:

- Etching tanks don't have to be removed from production-line service to drain and refill with fresh solution.
- Etching capacity of solution is continuously maintained at peak level.
- Regeneration of solution eliminates need for chemical makeup.

Bell's figures on process economics are startling. To etch 200 sq. ft. of 2-oz. copper normally takes about $75 worth of $FeCl_3$ and HCl. The Bell process would consume only 20¢ worth of electricity and recover $5 worth of copper to boot.

New polyethylenes pose tough problems

With startup of one high-density polyethylene plant in February and another scheduled for this month, Union Carbide's Bakelite Div. has handed its engineers two urgent and challenging assignments:

- To production men, get the two new plants running smoothly, with complete control over quality of products.
- To marketing men, develop volume outlets for the full capabilities of the two plants—30 million lb./yr. of 0.95-density Ziegler-process resin from Institute, W. Va., and 25 million lb./yr. of 0.96-density Phillips-process resin from Seadrift, Tex.

Bakelite production engineers name as their toughest problem the need for almost sanitary conditions in the polymerization process. Slight traces of metallic contaminants (e.g., iron) affect polymerization rate and character of product.

But the labor pains of plant startups may be forgotten by the time marketing headaches are relieved. At 43¢/lb., high-density polyethylene will have an uphill fight against lower-priced, well-established products like conventional polyethylene and high-impact polystyrene. While Bakelite hopes to switch some users of other plastics over to its new polyethylenes, company spokesmen point out that prime efforts are aimed at creating entirely new markets. Even here, competition from other producers of high-density polyethylenes will be fierce.

In the container field, Bakelite expects high-density polyethylenes to compete with glass, tinplate and aluminum. Resistance to heat will make it possible to sterilize food products after packaging in polyethylene.

Fluid bed invades cement industry

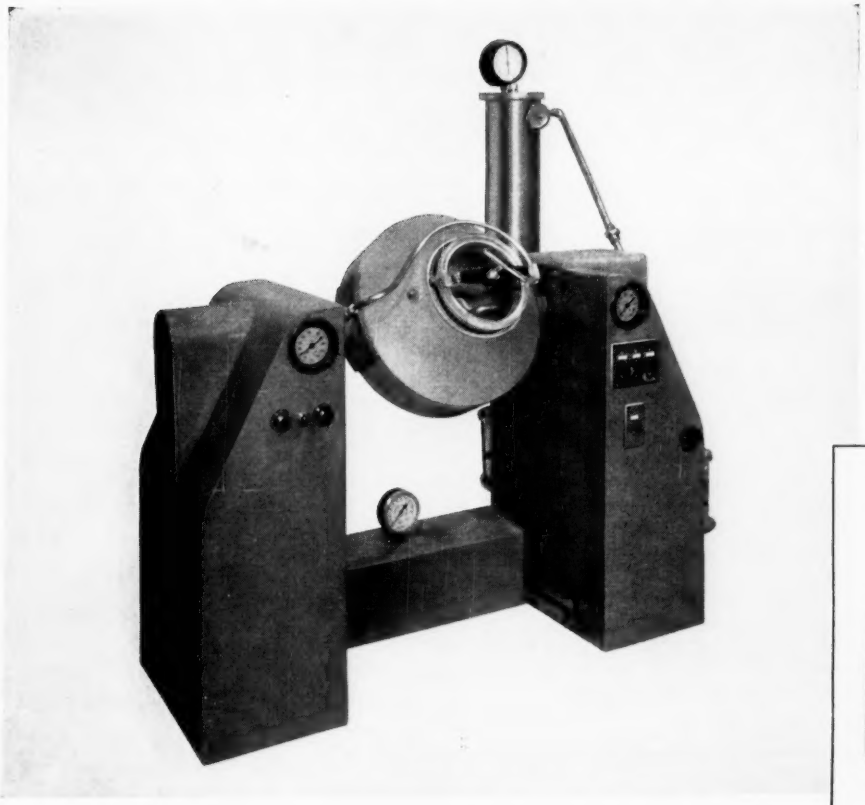
Equipment engineers are giving the cement industry's relatively stable technology a shot in the arm as they vie for contracts to equip the new mills needed for stepped-up road-building programs. Two mills are already using new ACL calcining kilns (*see p.* 60).

Fuller Co., Catasauqua, Pa., now reveals that construction of its final fluid-bed development unit is nearly complete. Located at a nearby cement plant, the 1,000-bbl./day unit will be a 20:1 scale-up from a 50-bbl. pilot unit at Fuller's own laboratory.

By summer's end, Fuller hopes to have conclusive proof that the Pyzel fluid-bed process offers substantial fuel economy along with low investment. Earlier work with the smaller unit demonstrated that the Pyzel reactor produces uniform clinker that contains little alkali or free lime and that requires much less power for grinding. And Fuller has worked with many materials producing different types of cements to determine how versatile the process may be.

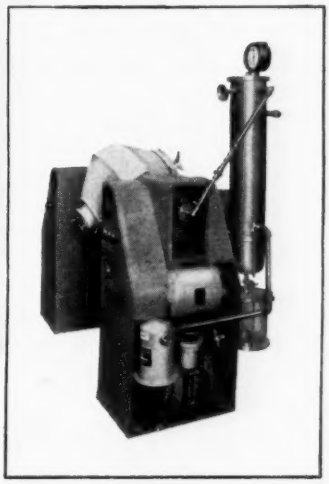
When Fuller launches the Pyzel process commercially, the company will design and manufacture the process equipment to suit individual customer needs. If desired, Fuller will also handle plant construction.

For more on DEVELOPMENTS.....60



Completely integrated vacuum drying system using P-K Vacuum Tumbler Dryer Blender.

Side view, showing vacuum pump, condenser and related components. Note compact arrangement and short lengths of piping.



The P-K Vacuum Tumbler Dryer

A faster, better way to vacuum-dry heat sensitive materials

The remarkably fast drying action of the P-K Vacuum Tumbler Dryer—a fraction of the time required by conventional methods—is partly accomplished by baffling in the jacket, which circulates the heating medium uniformly around the containing vessel. In addition, rapid generation of vapors produces a scrubbing action on the walls of the blender, improving the heat transfer rate to a marked degree.

These factors, important as they are, do not tell the whole story. The P-K Dryer operates at optimum efficiency when it is part of a completely integrated, factory engineered system, instead of an on-site assembly of component parts and piping—which increases the cost and impairs the attainable benefits. For heat senstive material drying, in a closed system, there must be a perfect balance of jacket circulation, vapor filter, vapor line, *compact* piping, vacuum line, vacuum pump and effective controls.

These essential relationships P-K provides, including factory designed supports to house the entire operation. The illustrations show a unit used in P-K's Customer Service Laboratory to pre-test the specific requirements of your formulae. You are urged to use this service without cost or obligation. Similar integrated units can be designed for your needs in capacities from 1 to 150 cubic feet.

Use the coupon to secure Data Sheet No. 1530. Better yet, contact our Customer Pre-test Department for a test if your heat sensitive formulations are difficult to produce rapidly, satisfactorily—and economically.

Patterson Kelley

Chemical and Process Division

Executive offices and plant: East Stroudsburg, Pa.

P-K "Twin Shell" Blenders • Heat Exchangers • Packaged Pilot Plants • P-K Lever-Lock Doors • P-K Cone and Ribbon Blenders

Patterson-Kelley Co., Inc.
1504 Hanson Street
East Stroudsburg, Pa.

Send me the information on vacuum drying checked below:

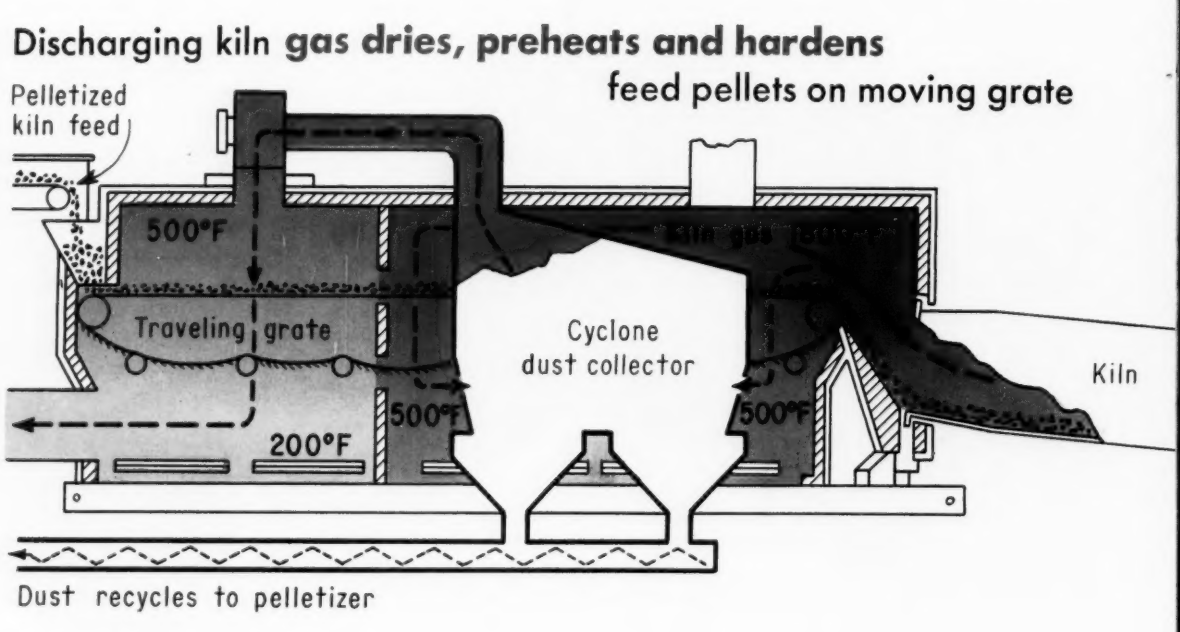
☐ Data Sheet No. 1530
☐ P-K pre-test of our product

*Name*_____ *Title*_____

*Company*_____

*Street Address*_____

*City*_____ *Zone*____ *State*_____



Two U.S. Cement Mills Now Save Fuel, Avoid

U. S. version of top cement process lives up to advance billing from overseas plants. By processing pellets, system utilizes heat better without dust loss.

While cleanliness may have stood next to godliness in the schoolboy's copybook, in today's cement industry plant operators rank cleanliness second only to thrift.

Combining these two virtues in a neat package is the ACL system for burning cement clinker. First U. S. installation—Marquette Cement Mfg. Co.'s 4,000-bbl./day, $7-million plant in Milwaukee—started up early last year.

Startup of the second ACL unit—3,500 bbl./day, $5 million—came in October. This one is at Diamond Portland Cement Co., Middle Branch, Ohio. Diamond shifted into high gear quickly, aided by Marquette's operating experience and a favorable raw materials base at Middle Branch.

▶**Saves Heat, Space, Dust**—In the ACL system* the hot, dust-laden exit gases from the rotary kiln make two passes through pelletized kiln feed which is on its way to the kiln via a moving grate. This arrangement yields these significant dividends:

• Fuel consumption is lower than with conventional systems. Diamond Portland has shown savings of some 30-40% in this respect.

• Space requirements are also 40% less. Diamond's setup takes up a total of 244 ft. of length, with a 160-ft. rotary kiln and an 72-ft. grate. A typical wet-process kiln for the same duty would be 450 ft. long.

• Dust loss with the ACL system runs less than 1%, compared with 10-15% for a conventional dry-process kiln.

Other advantages include ability to use any type of fuel, smooth kiln operation, uniform product.

▶**Avoids Air Pollution**—Cleanliness in Marquette's operations is all-important to the local citizenry. The new plant is but a short walk—even for an editor enslaved by New York's taxi habit—from one of Milwaukee's finest hotels.

And when Columbia-Southern Chemical Co. recently ran into objections from Barberton, Ohio, residents over its proposal to build a cement plant in that area, C-S officials sponsored an investigative junket to Milwaukee to convince city councilmen that a cement plant can be dustproof.

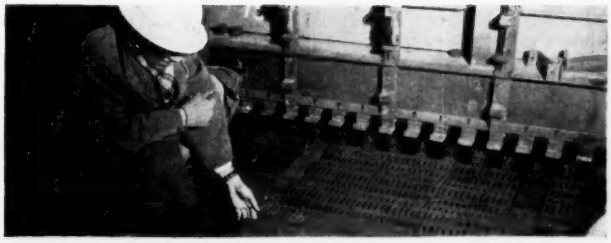
▶**Proved in Pilot Plant**—Proof of the process pudding was provided by a pilot plant built by Allis-Chalmers in Carrolville, Wis.

A-C has run tests to determine the suitability of various raw materials for making cement in

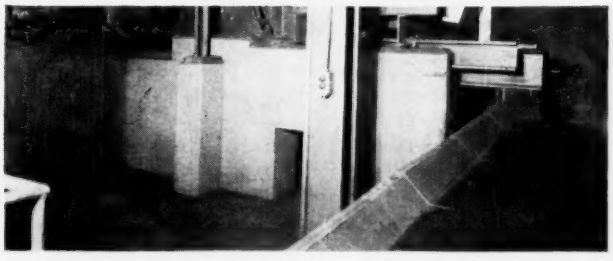
* For Allis-Chalmers-Lellep. Allis-Chalmers Mfg. Co., Milwaukee, is the exclusive licensee of the patented process developed in Germany by O. G. Lellep and now used in some 70 cement plants.



FEED pellets form on this 15-ft. dia. revolving pan, then drop onto ACL grate.



GRATE carries pellets through hot chambers.



CALCINED clinker drops onto conveyor from cooler where it has given up its heat to secondary combustion air.

Dust Losses With New ACL Calcining Systems

the ACL system. Of all the mixtures tried to date (limestone, clay, shale, silica sand, blast-furnace slag, fly ash), 95% of them pelletized well and made good cement.

There are also indications that the ACL kiln system has great promise for lime burning, phosphate rock nodulizing, ore treating and similar operations.

▶ **Pelletizing Comes First** — Here's how the ACL system works, as exemplified by Diamond's operations:

Dry, finely ground and blended limestone and shale (85-90% minus 200 mesh) are fed into a pan-type pelletizer (there are two installed) with 10-12% water. Flat bottom (back plate) of the pelletizer is inclined at 50-60° from the horizontal and is adjustable. The 15-ft.-dia. pan rotates at 8-10 rpm., rolling the raw materials into ¼-⅜-in. pellets.

Operating as a self-classifying unit, the pelletizer forces the fines to filter down through the pellet charge and remain at the bottom of the load until they form seed pellets—or add to other pellets—and grow to discharge size. A number of variables—pelletizer's slope, speed of rotation, pan depth, position of feed spout and water spray, dry feed rate and water feed rate—control pelletizer operation.

▶ **Drying and Preheating**—Pellets discharge over the pelletizer lip and drop onto a belt feeder which conveys them to the traveling grate. The grate is 12½ ft. wide, 72 ft. long, moves at 2½ fpm. and carries a layer of pellets about 7 in. thick. Its enclosure is split by a refractory wall into drying and preheating

Diamond Cement Plant Shows Clear-Cut Advantages

	Typical Conventional Systems		Diamond ACL
	Dry	Wet	
Kiln length, ft.	360	450	160 (+ 84 for grate)
Kiln diameter, ft.	12	11½	12½
Exit gas temp., °F.	1,200	550	250
Fuel, Btu./bbl.	900,000	1,000,000-1,100,000	630,000
Dust loss, %	10-15%	5-10%	0.5-1.0%

chambers, 26 ft. and 43 ft. long, respectively.

Pellets enter the drying chamber first and meet a 500-600 F. downdraft flow of kiln offgas, which is cooled to as low as 250 F. as it passes through the pellets. Pellets move continuously into the preheating chamber, where they are 20-35% calcined and heat-hardened before entering the rotary kiln. Kiln exit gases drop from 1,800-1,900 F. to 500-600 F. while doing this part of the job.

In passing twice through the bed of pellets, the exit gases deposit most of their load of dust. Contact with the moist pellets in the drying chamber is especially effective in dust removal.

▶ **Final Calcining**—Burning to clinker takes place in the coal-fired, 12½-ft.-dia., 160-ft.-long rotary kiln at about 2,500 F. Hot clinker leaving the kiln is cooled in an oscillating cooler to recover heat and aid in further processing. Clinker is then ground and packed as in conventional plants.

Ideally, pellets should survive the mechanical action of the rotary kiln and emerge as pellets of clinker. Ability to approach this ideal depends largely on the inherent plasticity of the raw-material mix. Diamond Portland, with a fairly plastic mix, has achieved a high degree of pellet survival, with the resulting advantages of easier kiln operation and product quality control.

Two More Steel Firms to Get On-Site Oxygen Units

Add two more companies to the list of steel firms with on-site oxygen-producing facilities: Pittsburgh Steel Co. at Monessen, Pa., and Detroit Steel Corp. at Portsmouth, Ohio. Both units are based on Linde Co. oxygen process.

Detroit Steel's unit, under construction, will turn out up to 20 million cu. ft./mo. of high-purity (99.5%) oxygen for furnaces and other mill operations. Plant will be designed for automatic, untended operation. An electric monitoring system keeps tabs on operation of all important components and reports continuously to a central office.

Linde owns and operates the oxygen unit, now on stream, at the Pittsburgh Steel site. Plant is producing about 126 tons/day of low-purity oxygen (95%) and 14 tons/day of high-purity oxygen.

Polyethylene Blanket Saves Taxpayer Dollars

Taxpayers in Edmonton, Alta., were saved a tidy sum when its city engineers came up with an uncommon answer to a common problem.

City had to waterproof the sludge lagoons at its new sewage processing plant. Conventional asphalt lining of the two 6-million-gal. lagoons would have cost $50,000. But for only $6,000, engineers were able to line the lagoons with polyethylene film.

Approximately 200,000 sq. ft. of film was used in the project. Strips of film 8 ft. wide were laid in the lagoons and welded into a continuous quilt with an electric iron. Carbon black had been incorporated into the film to strengthen it.

Lighter-than-water film is held down by sand-filled film "pillows."

Flexible Process Tactics Capture Nuclear Products

Key to Davison Chemical Co.'s new $2-million plant at Erwin, Tenn.—private industry's first completely integrated plant for making thorium and uranium products—is process flexibility.

For in addition to manufacturing uranium and thorium metals, the plant is equipped to turn out natural and enriched uranium oxides, thorium oxide and thorium-magnesium alloy. Too, the plant will be able to reprocess fuel scrap commercially.

▶ **Uranium: Three Routes**—Raw material for uranium products is UF_6 from Oak Ridge gaseous diffusion plant.

Hexafluoride undergoes hydrogen reduction to "green salt" (UF_4) and further reduction to metal by calcium or magnesium.

Alternatively, green salt may be reacted with steam to make uranium dioxide (UO_2).

In wet process for intermediate and high-enriched fuel, UF_6 is converted to dioxide by ammonium diuranate process (*Chem. Eng.*, Jan. 1957, p. 114).

▶ **Thorium Route** — Thorium concentrates from Davison's Curtis Bay, Md., plant are processed to thorium oxide or metal. Concentrate is digested in nitric acid, then solvent-extracted in four 6-in.-dia., 40-ft.-high pulsed columns (two for extraction, two for stripping solvent). Oxalic acid precipitates thorium oxalate which is fired to oxide for fuels or for reduction to metal.

Convention Calendar

American Ceramic Society, 60th annual meeting, Penn Sheraton Hotel Pittsburgh, Pa., April 27-May 1.

American Assn. of Cost Engineers, Mid-Atlantic Section, 1st annual symposium, Hotel Manhattan, New York, N. Y., April 29.

Fifth Annual Conference for Engineers and Architects, with technical sessions on Nuclear Engineering, Computers and Automatic Controls, Ohio Union, Ohio State University campus, Columbus, Ohio, May 2.

Thirteenth Purdue Industrial Waste Conference, Purdue Memorial Union Building, Purdue University, Lafayette, Ind., May 5-7.

American Institute of Chemical Engineers, New Jersey Section, 9th annual symposium, Catalysis, Solids-Liquid Separation, Hotel Essex House, Newark, N. J., May 6.

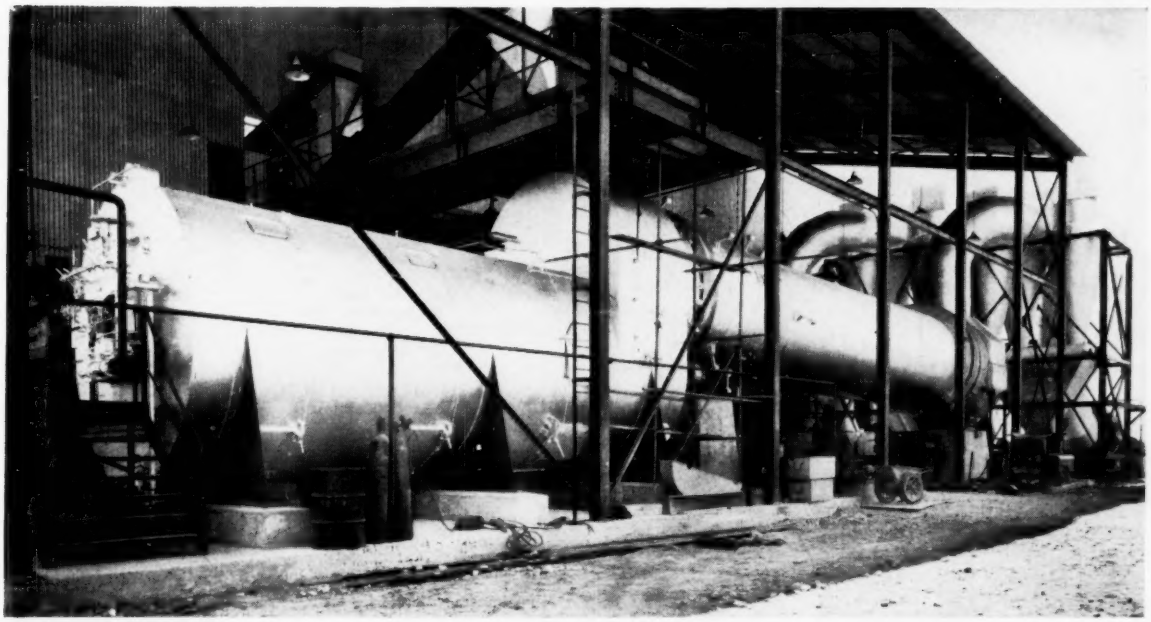
American Petroleum Institute, Division of Refining, midyear meeting, Statler Hotel, Los Angeles, Calif., May 12-15.

Electrochemical Society, with sessions on Electrothermics, Metallurgy and Industrial Electrolytics, Statler Hotel, Washington, D. C., May 12-16.

Technical Assn. of the Pulp and Paper Industry, 9th Coating Conference, Bedford Springs Hotel, Bedford, Pa., May 14-16.

Helping others produce a better product...

STANDARD HERSEY DRYERS



ORTHO

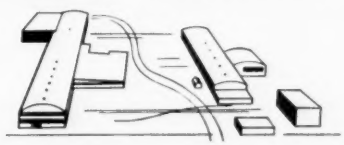
TO ENRICH THE SOIL FOR GREATER FOOD SUPPLY CALSPRAY'S© NEW PLANT IS ON STREAM... WITH STANDARD-HERSEY DRYERS!

To provide better fruit, vegetables, meats ... and lower farmers' "production" costs, California Spray-Chemical Corporation's new plant is now on stream at Richmond, California, increasing the production of its famous-for-quality ORTHO Fertilizer. With a rated capacity of 300 tons-per-day, Calspray's new plant uses two *job engineered* Standard-Hersey dryers designed and built by the experienced engineers of Standard Steel Corporation ... a world leader in better designs of dryers, granulators, and coolers. Wide range and flexibility are provided to make almost any desired grade of fertilizer.

Regardless how tough the problem, if you're looking for a *job-engineered* rotary unit, you'll look to Standard Steel.

IF YOU HAVE A PROCESSING PROBLEM!

Standard Steel welcomes the opportunity to discuss with you any problems you may have in drying, cooling, or calcining. Our laboratory pilot testing equipment determines beforehand the best equipment for your problem.



STANDARD STEEL ACQUIRES LEADER IRON WORKS

SINCE Leader 1888

To meet the ever increasing needs of its world-wide customers, Standard Steel Corporation recently purchased the Leader Iron Works at Decatur, Illinois. Founded in 1888, Leader is well known for its work in the food, chemical and petroleum industries. In addition to its customary fabrication, Leader will now manufacture Standard's line of heavy processing and road construction equipment.

ORTHO T. M. REG. U. S. PAT. OFF. CALIF. SPRAY-CHEMICAL CORP.

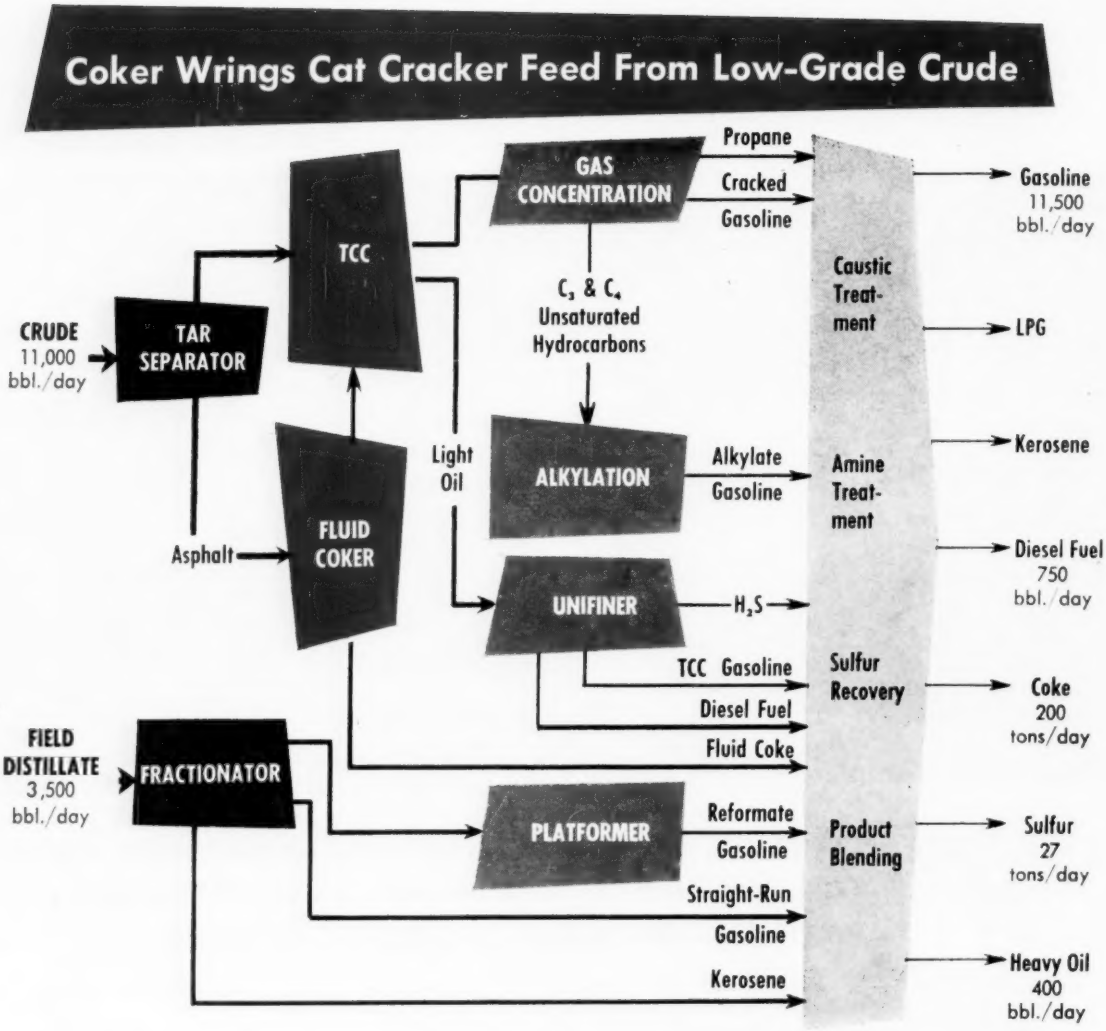
STANDARD STEEL CORPORATION

General Offices & Plant, 5005 Boyle Avenue, Los Angeles 58, California

Midwest Offices & Plant **LEADER IRON WORKS** *Decatur 5, Illinois*

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Coker-Cracker Combo Solves Refining Riddle

Refining scheme taps reserves of low-grade Mississippi crude to bring in a new source of gasoline for southern markets.

How to tap low-grade crude petroleum to satisfy a predominantly gasoline market is now demonstrated conclusively by Pontiac Eastern Corp., Purvis, Miss. Using a new refining scheme, Pontiac's new Black Creek refinery produces 11,500 bbl./day of gasoline products from 11,000 bbl./day of heavy, sour, Mississippi crude oil and 3,500 bbl./day of sweet field distillate. Total gasoline yield: 79%.

▶ **Mismated at Start**—While south Mississippi oil fields are potentially good producers, until Pontiac's opening their output of low grade crude funnelled only into fuel oil and asphalt markets. Upgrading to satisfy the large-volume gasoline market had not been feasible. Raw material and market just couldn't get together.

▶ **New Team Breaks Through**—Now, though, Pontiac has uncorked the bottleneck by teaming a fluid coker with a Thermofor Catalytic Cracker (TCC) to produce a product mix geared to local requirements.

Roughly, three quarters of plant feed stock is Mississippi crude which is converted largely into TCC feed stock by a flash tar separator and fluid coker, with a small fraction discharged as coke. Streams discharging from the TCC unit go through conventional refining steps and blending with cuts from the sweet field-distillate feed stream which makes up the remaining 25% of plant throughput.

Aside from Pontiac's novel

REFINISHING ENAMEL—
85% of original gloss after 24 months' weathering



Photovolt gloss meter reading of car repainted with new Isophthalic-based refinishing enamel. After repainting, the car was not waxed—has never been garaged, polished, and was washed only occasionally. Reading shows 85% of original gloss after 24 months' weather exposure—a wide margin of superiority in gloss retention, hardness and durability over conventional high quality commercial grade enamels.

Still another test conducted under severe Florida weather conditions compared an Isophthalic-based automotive refinishing enamel to several high quality Phthalic Anhydride based auto refinish enamels. The result? After 6 months of rugged weather exposure the Isophthalic-based enamel had over twice the gloss retention of the PA based products.

What improvements are you looking for in *surface coatings? Hardness of finish. Better resistance to film checking or cracking. Better adhesion to metal surfaces. Longer life in coatings. Greater flexibility. Better through-dry.* Whatever property or properties you need in protective coatings — Oronite* Isophthalic can provide them.

If your paint supplier can't provide Isophthalic-based coatings to your individual needs, Oronite can show him how to make them. Resin samples are available as well as data on their formulation and instructions on their preparation. Just contact the Oronite office nearest you.

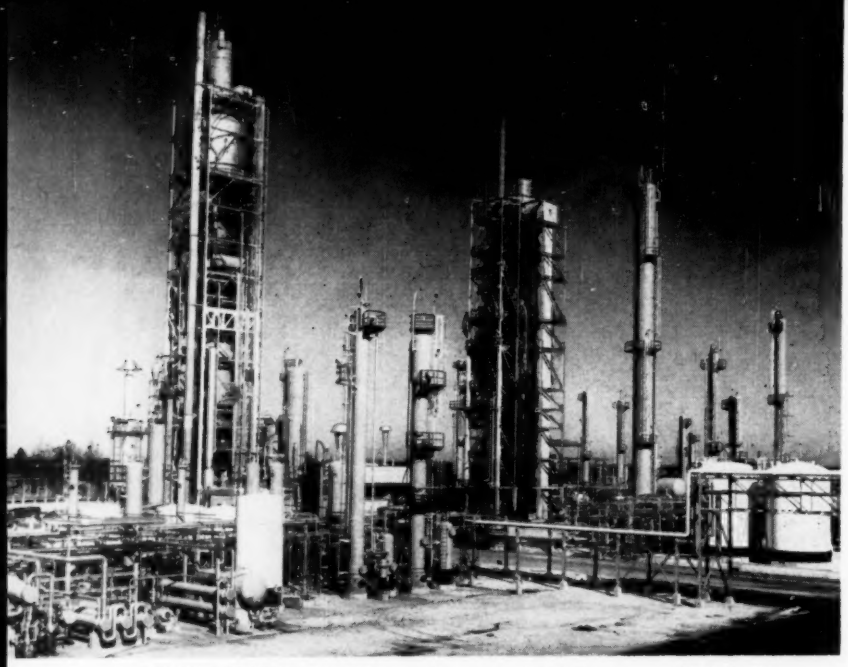
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*T.M.

4781



FLUID COKER (right) provides main feed stream to TCC (left).

use of the fluid coker directly in the main process stream of its $20 million plant, there's another reason why process reaches such a high gasoline yield. That's because the TCC unit is sized to recycle 2 bbl./bbl. of feed, a throughput equivalent to a normal 50,000 bbl./day refining operation.

▶ **First Steps Crucial**—Incoming crude oil enters a flash vaporizer to divert volatile material directly to the TCC unit. Liquid asphalt fraction goes to fluid coker for conversion into light overhead stream suitable for TCC feed, and a high-grade coke.

Classification of coke splits off coarse product and recycles fines back to coker.

Feed streams entering the TCC unit are cracked to lighter hydrocarbons which are then refined and blended to final products.

▶ **Final Squeeze**—Light oil diverted from the TCC recycle stream flows to the Unifiner for catalytic hydrogenation at approximately 750 F. and 800 psig. to convert combined sulfur to hydrogen sulfide. Sulfur-free hydrocarbon yields gasoline and diesel fuel on fractionation.

Gas concentrating unit uses fractionation and absorption to split TCC gas discharge into ethane and lighter gases for refinery fuel, propane for sale as LPG, butane for alkylate, and cracked gasoline.

Sulfuric acid alkylation converts butane and isobutane at 55–60 F. into high-octane blending alkylate. Caustic treatment removes residual acid from the product.

All streams that contain hydrogen sulfide pass through amine scrubbers. Hydrogen sulfide gas recovered from amine solutions is catalytically reduced to elemental sulfur.

▶ **Sweet Stream**—Fractionation of the incoming field distillate stream yields: Straight-run gasoline, kerosene for sale and blending in diesel fuel, straight-run naphtha, and bottoms which are combined with crude oil feed.

Naphtha is Platformed over a platinum-containing catalyst at 975 F. and 500–600 psig.; reformate is a high-octane, gasoline-blending component.

▶ **Connecting Links**—Crude oil flows to refinery from Lumberton field through 13-mile PEC pipeline. Another PEC pipeline, a 42-mile run to Collins, Miss. on the Gulf, delivers products to the terminal for distribution to points farther eastward.

▶ **Look for Long Runs**—Both PEC and Fluor engineers, who designed and constructed the plant, are gratified with the smooth operation of the fluid coker. They confidently expected to operate for 12 to 18 months without any maintenance shutdown.

Foamed Adhesives Claim Big Plywood Economies

A new technique for foaming adhesives makes possible superior bond strength using less adhesive and holds out promise of $2-million annual savings in production of Douglas fir plywood alone.

Developed by Arthur D. Little's Western Div. in conjunction with American Forest Products and two plywood manufacturers, aeration technique can be used with most standard adhesives (including phenolics). Previous European-developed foaming techniques could be applied only to urea resin glues.

Key to process success is design of foaming equipment and modification of adhesive formulations. Foaming expands volume of adhesive four or five times giving stable foam and uniform spread, cuts plywood gluing costs by 20%.

Puerto Rico Will Get Synthetic Fiber Plant

Early next month Puerto Rico's first synthetic fiber plant will be abuilding.

Beaunit Mills, Inc., will build the multimillion-dollar plant to produce 10 million lb./yr. of synthetic polymer fiber ("noncellulosic," the firm adds), including tow and yarn spun from tow.

The fiber, explains company president I. Rogosin, may be used alone or blended with other natural or synthetic fibers. Target on-stream date is June, 1959.

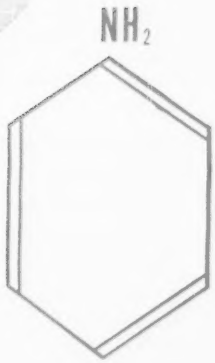
Platinum Catalyst Keys New Isobutane Process

Key to Universal Oil Products' new butane-isomerization process, revealed UOP's H. W. Grote last month, is a specially prepared platinum-containing catalyst. Catalyst operates at relatively low temperatures so that isobutane content in reactor efflu-

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Our aniline is made in modern twin, continuous catalytic-hydrogenation units by a patented process developed out of our 74-year experience in aniline manufacture. As made, it is water white (Barrett Standard 1.0), pure (99.9%) and dry (moisture .04%). Those are shipping specs but we regularly load cars analyzing as high as 99.95+%.

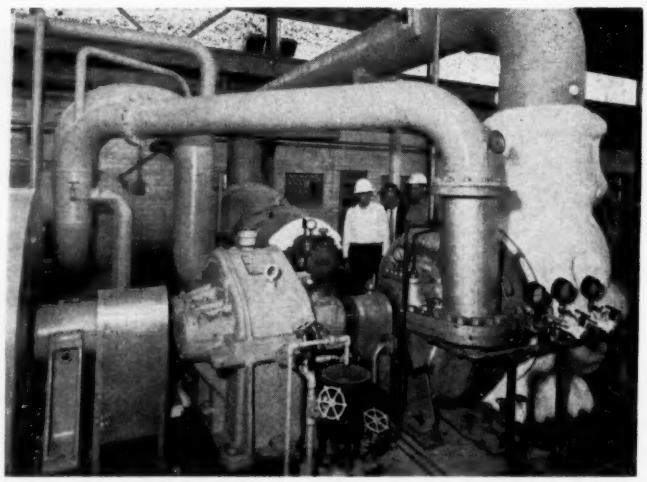
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Unit Doubles in Refrigeration and Process Flow

Two-stage, 770-ton refrigeration unit at U.S. Steel's new nitrogen products plant at Geneva, Utah, performs two functions: It refrigerates three process steps and serves as partial supply of ammonia for nitric acid and ammonium nitrate units. Supply is obtained by bleeding off first-stage compressor discharge of refrigeration unit. (See *Chem. Eng.*, Feb. 10, 1958, p. 72.)

Ammonia vapor enters low-stage compressor (right foreground) at −23 F., 16 psia., leaves at 71 psia. Gas goes through interstage cooler then enters high stage at 69 psia., leaves at 199 psia., condenses in shell-and-tube condenser at 96 F.

ent is high enough to eliminate excessive recycle of n-butane.

Speaking at the spring meeting of the Western Petroleum Refiner's Association, Grote outlined the new process, called Butamer.

Butamer catalyst operates at temperatures of 600-850 F. under hydrogen pressure to produce equilibrium concentration of 50-40 mol-percent of isobutane in total butane effluent.

Reaction products are fed to deisobutanizer and unconverted normal butane is recycled to reactor.

Promising Find: Ductile Ceramics

Ceramics as a material of construction? Generally, ceramics are considered too brittle to find wide use even though they have desirable high-temperature properties.

But researchers at the University of California in Berkeley have produced ceramics that can be bent by hand without cracking. When single crystals of cubic ionics (e.g. MgO, KBr) are shaved with a chisel, exposing fresh crystal faces, the resulting smaller crystal can be bent easily. Big drawback: Most crystals lose their ductility after a short exposure to air.

One potential use for this laboratory find would be in field of rocket engines. Higher operating temperatures boost engine efficiency, but current upper limit of metal usefulness is around 2,000 F. Ceramic engine parts hold out real high-temperature promise if research licks the brittleness bugaboo.

For Rent: Cozy Sun-Heated Home

First sun-heated house designed to meet modern requirements for "gracious living" is ready to receive its first occupants. Designed by engineers and architects at Massachusetts Institute of Technology, the three-bedroom house in Lexington, Mass., will be rented to a private family while engineers continue studies on the solar heating system.

Dominant feature of the solar house is the heat collector, forming all of the visible wall and roof on the building's south side. Beneath 640 sq. ft. of two-layered glass is the black aluminum collecting surface. While the aluminum sheet absorbs the solar energy, the glass layer acts the same as it does in a greenhouse—lets sunshine in but keeps longer waves of heat energy from passing out again to the atmosphere.

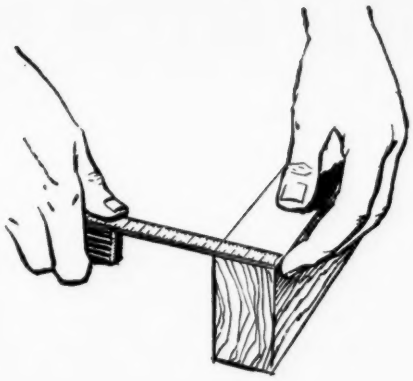
Water circulates through copper tubes attached to the aluminum collecter and cycles to a 1,500-gal. storage tank in the basement. Hot water from the tank heats air for the living space in a heat exchanger that is like an automobile radiator. To take care of extended cloudy periods, the hot water system is connected to an auxiliary oil burner.

And the cost? About six times a conventional system, say MIT engineers. But if costs can be pared down to only twice an ordinary system, then fuel savings will justify added expense.

New Ammonia Plant Uses Fuel Oil Feed

First ammonia plant using fuel oil as raw material, claims Canadian Industries Limited, is its $9-million, 200-ton/day plant at Millhaven, Ont., now on stream.

Air-liquefaction unit produces nitrogen for ammonia and oxygen (separated from nitrogen by distillation) for partial combustion of oil in a "Texaco generator." Generator exit gases, after removal of sulfides and mercaptans and stripping of carbon dioxide, supply hydrogen. Hydro-



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COMPARE WHEN YOU BUY — AND INSIST ON GETTING THESE FOSTER WHEELER STANDARDS

THICKNESS COMPARISON OF IMPORTANT TOWER COMPONENTS

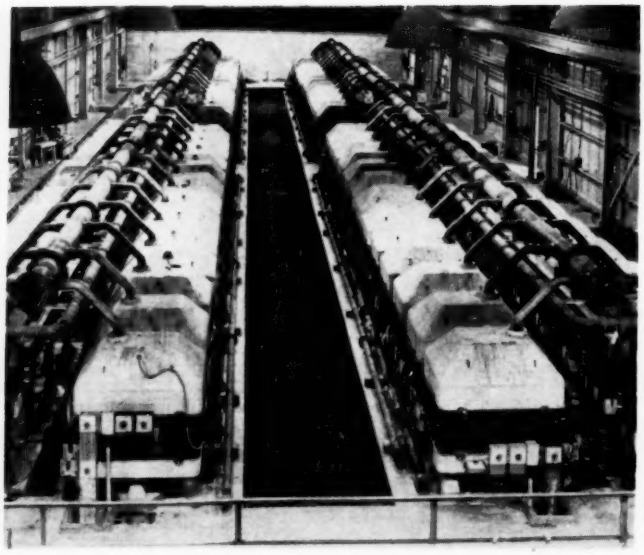
TOWER COMPONENTS	FOSTER WHEELER	MANUFACTURER "A"	MANUFACTURER "B"
SPLASH BARS	1"	1"	3/8"
FILL DECK SUPPORTS	2"	1"	1/2"
WATER DISTRIBUTION SYSTEM	2"	1"	1"
FAN STACK SHEATHING	1 1/2"	1"	3/8"
AIR INLET LOUVERS	1"	1/2"	1/2"
DRIFT ELIMINATOR BLADES	9/16"	7/16"	5/16"

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Caustic Plant Will Supply Nearby Alumina Works

With this lineup of Hooker 30,000-amp. electrolytic cells, Kaiser Aluminum & Chemical Corp. now produces 114 tons/day of caustic soda and 100 tons/day of chlorine at its new $8-million Gramercy, La., plant. Plant is the first built in U.S. to supply caustic soda to an adjoining alumina works (still under construction). Production also is sufficient to supply Kaiser's Baton Rouge alumina works and Chalmette reduction works. Olin Mathieson markets chlorine under long-term contract.

gen and nitrogen are converted to ammonia at roughly 5,000 psi. and 900 F., over an iron-containing catalyst.

Nuclear Fuels Center to Tame Reactor Plutonium

Argonne National Laboratory, Lemont, Ill., will build a $10-million fuels technology center to speed technological development of highly radioactive plutonium as fuel in nuclear power reactors.

Singmaster & Breyer is now working on design of the center, expects it to be completed early next year.

Type of work to be done at the center ranges from bench-scale experiments to moderately large casting and fabrication.

►**Recycle-Fuel Reactor**—In another phase of the fuels program, Argonne scientists and engineers are working on plans for Experimental Breeder Reactor No. 2, expect to swing it on stream in 1960 at National Reactor Testing Station, Idaho Falls, Idaho.

Completely integrated, fast-breeder EBR 2, according to Argonne project engineer Harry Monson, will operate on reprocessed fuel and will use prototype components. An unmoderated, sodium-cooled breeder reactor will turn out a rated 62,500 kw. of heat and 17,500 kw. of electricity.

Atomic Energy Commission has authorized $29.1 million for reactor design and construction, and $10 million for fuels technology center.

News Briefs

Allyl alcohol: Dow Chemical Co. has begun volume production of allyl alcohol at Freeport, Tex., will start producing allyl chloride in June or July this year. Allyl alcohol has minimum assay of 98%.

Liquid oxygen: Union Carbide, as part of its over-all $150-million expansion program this year, will boost capacity of liquid oxygen, nitrogen and argon plants at East Chicago, Ind., Ashtabula, Ohio, and Fontana, Calif.

Polyacrylonitrile fiber: VEB Filmfabrik, Agfa Wolfen, in Bitterfeld, East Germany, is now producing a polyacrylonitrile fiber with wool-like properties by spinning from a polyacrylonitrile-dimethyl formamide solution into a water-dimethyl formamide solution.

Hardboard: Bowater Board Co., division of Bowater Southern Paper Corp., will build a hardboard mill at Catawba, S.C. Processing only hardwood trees, Bowater will use a new dry-forming system to turn out board which is new premium quality with smooth finish on both top and bottom surfaces.

Pulp and paper: Champion Paper and Fibre Co. will build a 300-ton/day pulp and paper mill near Fairfield, Calif., 60 mi. northeast of San Francisco.

"Glass steel" plastic: Russian chemists at Leningrad Laminated Plastic Works have produced a plastic claimed to be as durable as steel but weighing 83% less. Soviet News, published in Britain, says chemists are now working to make plastic that costs less. Raw material is natural gas.

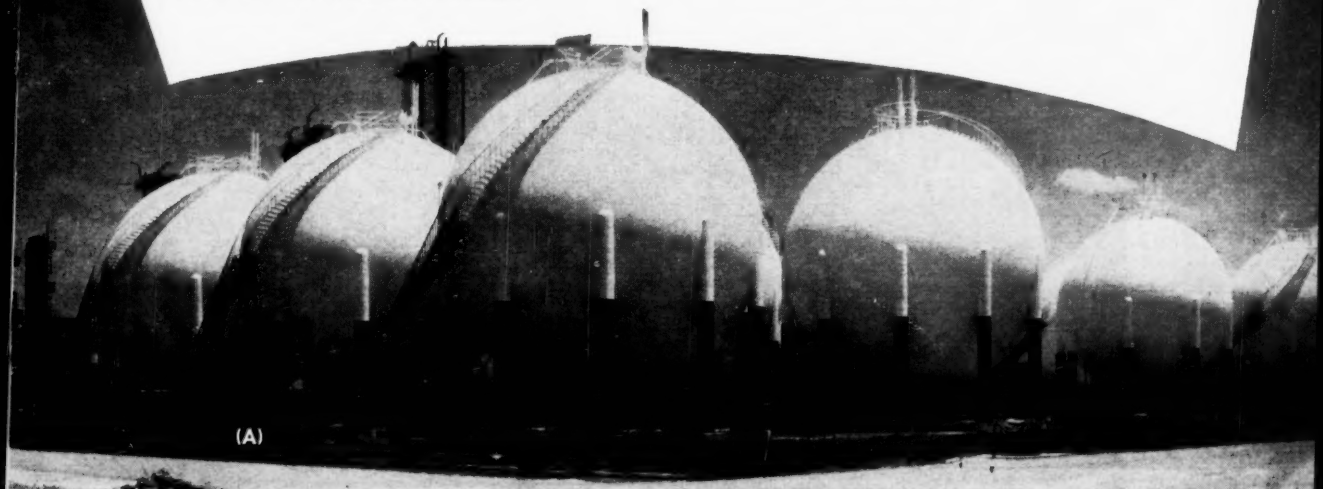
Drilling mud: Gulf Oil Corp., by using additives, has developed drilling muds with extreme-pressure lubricating properties; mud reportedly boosts bit life two to five times.

HORTON® STRUCTURES

for new TEXAS BUTADIENE plant

Included in the storage facilities of the new multi-million dollar plant of Texas Butadiene & Chemical Corporation near Houston, are CB&I fabricated structures, including 16 Horton Flat Bottom storage tanks, 19 Hortonspheres® and Horton Double-Deck Floating Roof tanks.

CB&I's experience in the design, fabrication and erection of modern steel petroleum processing or storage structures can match your most specific requirements . . . anywhere in the world. Write our nearest office for further details.





(A) 19 Hortonspheres range in capacity from 2,500 to 12,000 barrels and in pressures from 60 to 130 pounds.

(B) Two Hortonspheroids® storing 5,000 barrels each—are designed for 15 pounds per square inch working pressure.

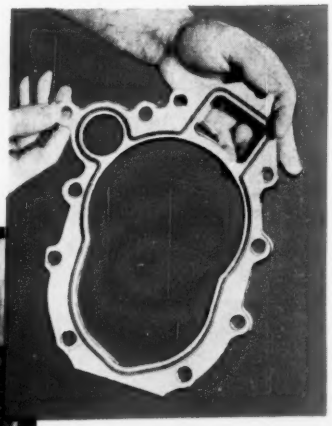
(C) Horton Double-Deck Floating Roof tanks store aviation gasoline.

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P61CB

Dubbed a **universal sealing material** by virtue of unique resistance to oils, fuels and solvents above 400 F. is Viton, new fluorinated rubber.





The new rubber is almost as **easy to process** and fabricate as GR-S — unlike heat resistant competitor silicone rubber.

Jet Age Rubber Resists Heat Plus Fluids

It stands up to exotic new fluids and high heats that came in with the jets.

Stimulating such superlatives as "universal sealant" and "rubber-like Teflon," new fluorinated rubber, Viton, is reported to have no equal among commercial elastomers in resistance to oils, fuels and solvents above 400 F.

Product claims mechanical properties that are respectable for any elastomer and excellent for one that is super resistant to heat and fluids. For example, tensile strength is 2,000-3,000 psi. at 77 F., 1,000 at 300 F., is retained over 90% at 300 F. when exposed to such fluids as tricresyl phosphate, No. 3 oil, Oronite 8200 silicate ester.

Viton's viscosity and plasticity are in the same range as present commercial elastomers. Its compounds, unlike silicone rubber's, are easily processed using standard equipment.

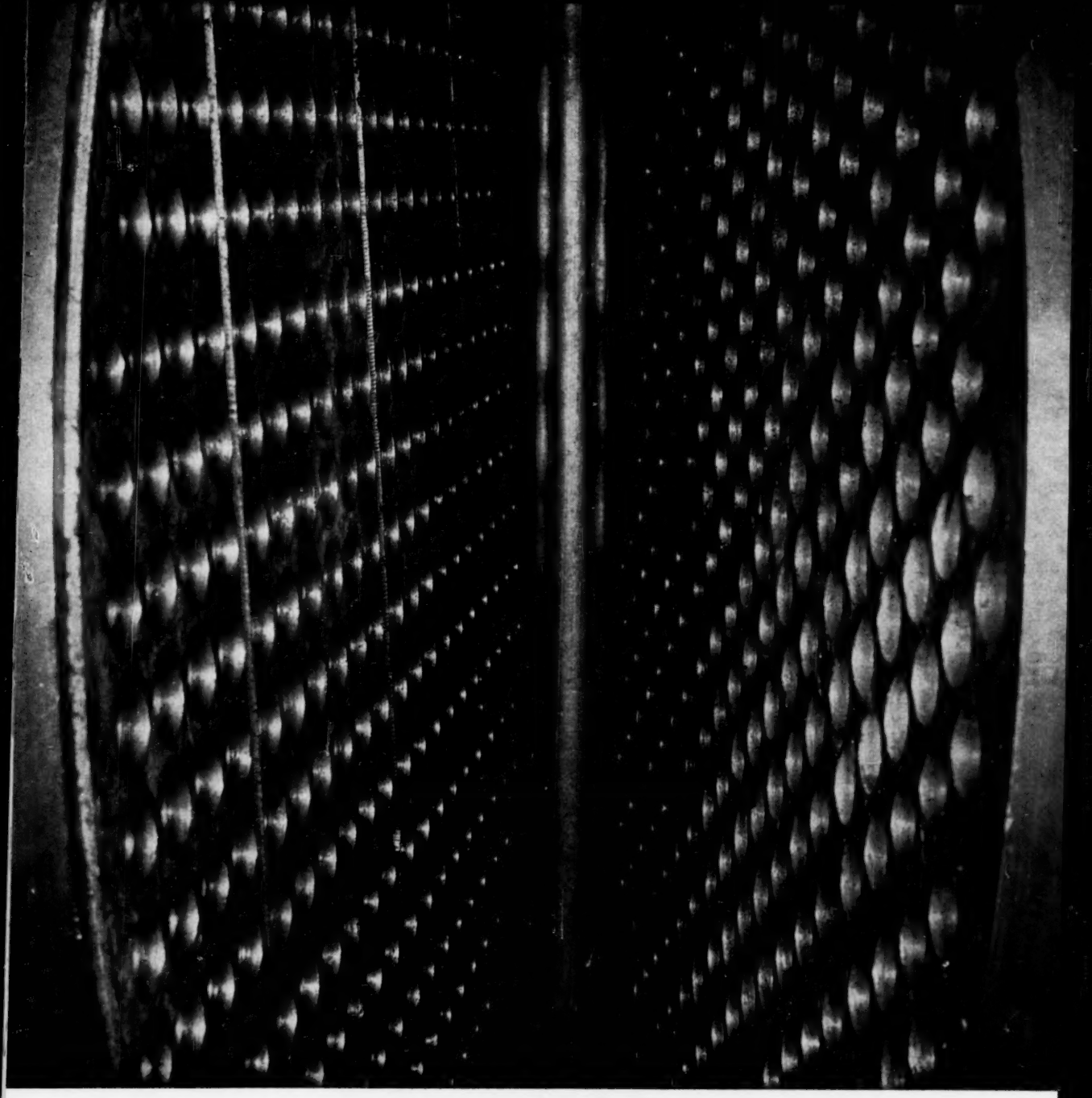
And, though high in heat resistance, no silicone rubbers have attained tensile strengths above 2,000 psi. and they do not stand up well to fluids. Even fluorinated silicone, newly developed to improve silicone fluid resistance, only retains this resistance to 400 F. Nitrile rubbers are fluid strong but heat weak.

Filling this gap, Viton has already been set for use in all seals in Sunstrand Aviation's hydraulic alternator drive, valve stem seals for Ford's heavy truck motors (sodium-cooled exhaust valves cause extremely high temperatures at the seals), seals for the metering section of Wayne Pump's gasoline pumps. There is a growing interest in its use in hose, protective clothing, fuel cells, wire insulations, caulking.

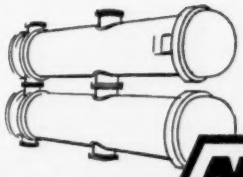
One class of fluids in which the unvulcanized Viton is soluble is the ketones. Thus high solid cements and spread-coating doughs can be made from it.

The product was developed by Du Pont and has been in pilot plant production since 1956. A linear copolymer of hexafluoropropylene (never before produced commercially) and vinylidene fluoride, it is about 65% fluorine by weight and has a specific gravity of about 1.85. Commercial production just started at Carney's Point, N. J.

Ultimate market volume for Viton is expected to be somewhat larger, though in the same ball park, with that for silicone rubber which now stands at about 5 million lb./yr. Even if Viton, which sells at an introductory $15/lb., continues to cost 2 to 3 times as much as competitors, Du Pont cites as a leveller its ability to last 7 times as long in many uses.—**Du Pont Co., Wilmington, Del.** 72A



READY TO ROLL from storage racks to bundling jigs, these heat exchanger tube sheets symbolize the assembly-line techniques developed by The M. W. Kellogg Company to speed fabrication, yet still adhere throughout to the highest standards of design and engineering. To assure the optimum in heat transfer equipment for petroleum refinery and chemical plant service, call Kellogg's Fabricated Products Sales Division.

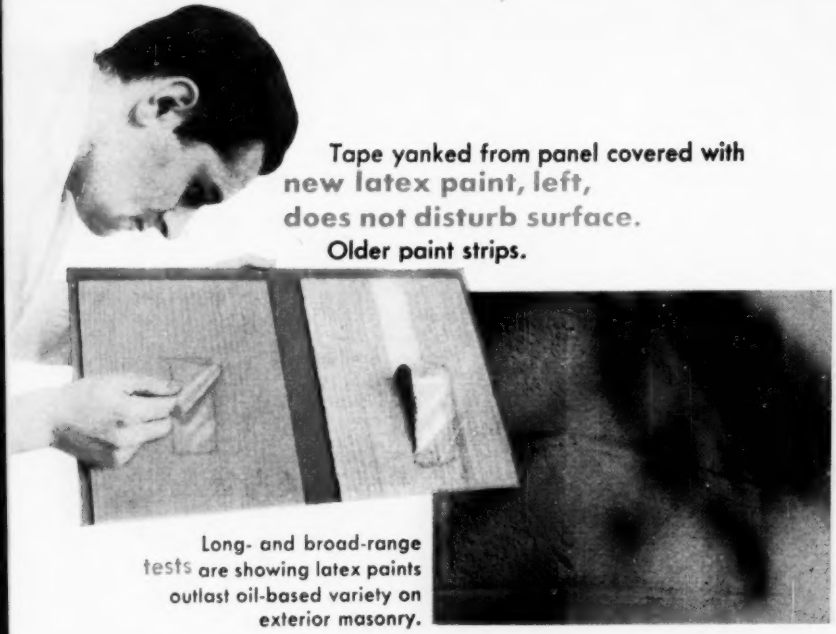


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M KELLOGG W



Tape yanked from panel covered with new latex paint, left, does not disturb surface. Older paint strips.

Long- and broad-range tests are showing latex paints outlast oil-based variety on exterior masonry.

Latex Paint Goes Outdoors

Outdoor use has been limited to fresh masonry. New formulations stick through old paint to shingle, wood.

Problems that have so far barred water-thinned paints from general use out-of-doors are reportedly overcome by polyvinyl acetate paints based on new Celanese formulations.

Major barrier has been surface adhesion; what use water-based paints have had outdoors has been pretty much limited to masonry surfaces. But the new formulations can be made to penetrate old, weathered paint, even though it be severely chalky and dirty, and to adhere to asbestos shingle, painted wood or other surfaces beneath. Common problems of peeling, blistering and scaling are avoided.

Key to the achievement is the use of a small percentage of aromatic solvents toluene or xylene in a formulation based on a unique type of polyvinyl acetate emulsion. Resultant paints show excellent durability for over three years.

Celanese reports that it is now working with several paint companies interested in commercially producing this type of paint. — **Celanese Corp. of America, 180 Madison Ave., New York, N. Y. 74A**

Another chapter on the life out-of-doors of water-based paints was added by a recent Bakelite progress report on long- and broad-range outdoor tests. Indications are that latex paint will outlast by a substantial margin the three-year life expectancy of a conventional paint job.

Tests are being made on masonry surfaces with company's WC-130, vinyl acetate resin already established for indoor use. Preliminary results indicate good performance on cement-asbestos shingles, concrete, stucco, brick and cement block.—**Bakelite Co., 655 Madison Ave., New York, N. Y. 74B**

Fluoro-Organics

Intermediates for drugs, fire-resistant plastics and anesthetics.

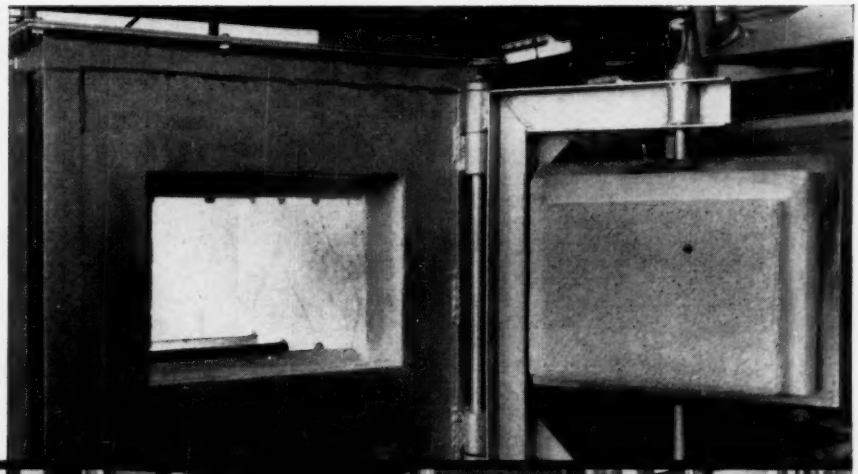
Two new intermediates, trifluoroethyl chloride and trifluoroethanol are said to be the basis for: a new approach to shock psychotherapy using trifluoroethyl derivatives; more stable, fire-retardant polymers of the trifluoroethoxy vinylic and acrylic types; safer and less flammable inhalation anesthetics of the halothane and vinylic ether types; dyestuffs of improved light-fastness.

Less fully utilized in industrial processing is an important technical concept of solvency. Trifluorethanol is a powerful ionizing solvent for organic materials and, importantly, does not irreversibly solvate the ions formed. These properties are expected to find direct major industrial use in common unit processes.—**Pennsalt Chemicals Corp., Philadelphia, Pa. 74C**

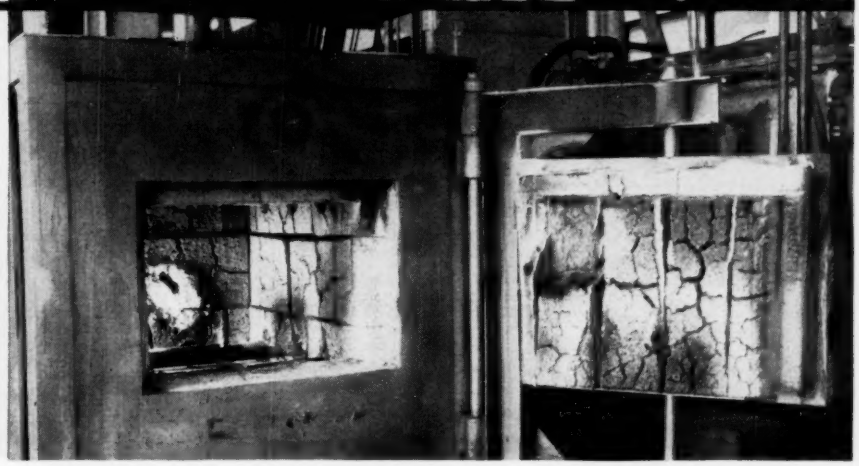
Newsworthy Chemicals

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Urethane foam insulates portable utility hut	76B
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For more details, use Reader Service Card



LINED WITH ALUNDUM 33-I CASTABLE, this furnace has been used for almost a year as a periodic furnace for high-temperature laboratory test work. During this time the door was opened and closed over a thousand times with the furnace at temperature. Even after this rugged service, the ALUNDUM Castable lining shows hardly any signs of wear.



LINED WITH A COMPETITIVE HIGH GRADE INSULATING BRICK, this similar furnace was used in the same service for an equal length of time. Under equally severe thermal shock conditions the lining cracked and spalled and this furnace must be rebuilt.

You get higher temperature protection with ALUNDUM* castables

Up to 3300° F!

ALUNDUM 33-I Insulating Castable is made up primarily of countless tiny, pure aluminum oxide bubbles. Forming a network of air spaces it provides excellent insulation, even at the highest commercial temperatures.

ALUNDUM 33-HD Heavy Duty Castable is chiefly composed of dense grains of pure aluminum oxide. It is recommended for forming dense monolithic surfaces in constructing many types of furnaces where high temperature conditions are more severe.

Both ALUNDUM 33-I and 33-HD Castables protect at temperatures up to 3300° F and are very easy to mix and use. You can cast simple or complex shapes with them quickly and inexpensively for many installations and replace more expensive pre-fired shapes.

See your Norton Representative for more facts on how these new Castables can provide long, trouble-free service that saves you time and money. Ask him for the folder *Two New Norton Castables*, or write for your free copy to NORTON COMPANY, Refractories Division, 503 New Bond Street, Worcester 6, Mass.

*Trade-Mark Reg. U. S. Pat. Off. and Foreign Countries

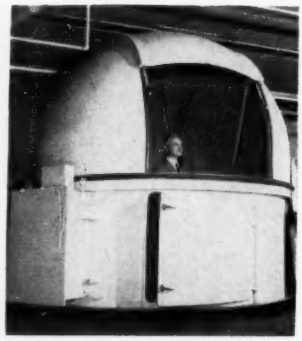
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Making better products... to make your products better

NORTON PRODUCTS:
Refractories • Abrasives
Grinding Wheels • Grinding Machines
BEHR-MANNING DIVISION PRODUCTS:
Coated Abrasives • Sharpening Stones
Behr-cat Tapes





Plastics in Rare Form: Mobile Structures

REVOLVABLE MINIATURE PLANETARIUM is of strong, light reinforced plastic. Called Astrodomes, these automatic, mechanical houses for complex and valuable instruments will be used to track missiles, satellites and future manned space vehicles.

The semi-spherical roof revolves 360 deg. on a track, and its dome splits automatically to any specified opening required to view the skies.—Cook Electric Co., Chicago, Ill. 76A

PORTABLE UTILITY HUT has light, urethane foam interlining. Foam is poured between formed sheets of aluminum, bonding to them securely and producing a rigid structure.

Called Helicop-Huts, they're transported easily by helicopter or truck, are finding armed service or civilian use as air traffic control or message centers, weather stations, disaster and emergency equipment, maintenance shops.—Craig Systems, Inc., Danvers, Mass. 76B

Polyethylene

For outdoor use, contains an ultraviolet inhibitor.

First polyethylene plastic to be specifically compounded with an ultraviolet inhibitor for use in molding or extruding outdoor products has ben introduced. This polyethylene compound, in natural or colors, incorporates a newly-developed ultraviolet inhibitor. It will last two to four times longer outdoors than polyethylenes that contain no inhibitors to protect them from the sun.

Film extruded from it remains pliable and smooth under accelerated weather testing in the laboratory at least twice as long as film of the same thickness extruded from polyethylene without the ultraviolet inhibitor. Molded section of the outdoor formulation show even longer life expectancy—up to four times greater than uninhibited sections. — **Eastman Chemical Products, Inc., 260 Madison Ave., New York, N. Y. 76C**

Adhesives

Radiation-resistant adhesive; bond for vinyl and nylon or Dacron fabrics.

A low-cost, effective radiation barrier which can be taken down and reassembled elsewhere owes its success to a new radiation-resistant adhesive replacing conventional mortar.

Called Weld-O-Bond No. 3111, it does not turn brittle nor deteriorate under prolonged exposure to radioactivity. It has good compressive and sheer strength but not appreciable tensile strength so that the wall can be disasembled at any time, block-by-block, without damage to blocks. A vinyl-based compound, it is dyed a brilliant blue so that any gaps in the bond can be readily seen. — **California Stucco Products of New England, Inc., Cambridge, Mass. 76D**

Strength limitations on bonding of vinyl compounds to fabrics of nylon or Dacron polyester fiber are said to be overcome by new NVD adhesive. Previously, this type of coated fabric has been restricted in end uses such as truck, boat and hatch covers and oil well drilling rig shelters, where flexing is common. Flexing caused separation of vinyl from base fabric.

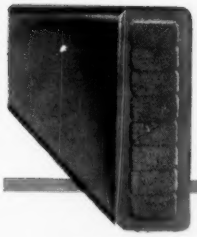
The new adhesive has shown results as high as four times the strength of current adhesives used. Current average bond strength is about five pounds per inch, and some bond strengths attained using NVD adhesive have been in excess of 20 pounds per inch.—**Du Pont Co., Wilmington, Del. 76E**

BRIEFS

Magnesium methylate is now commercially available in five and ten percent solutions in methanol. Some of its applications are in the manufacture of magnesium salts of organic acids, as a specialty coating for metals and plastics. — **Pioneer Chemical Works, Philadelphia, Pa. 76F**

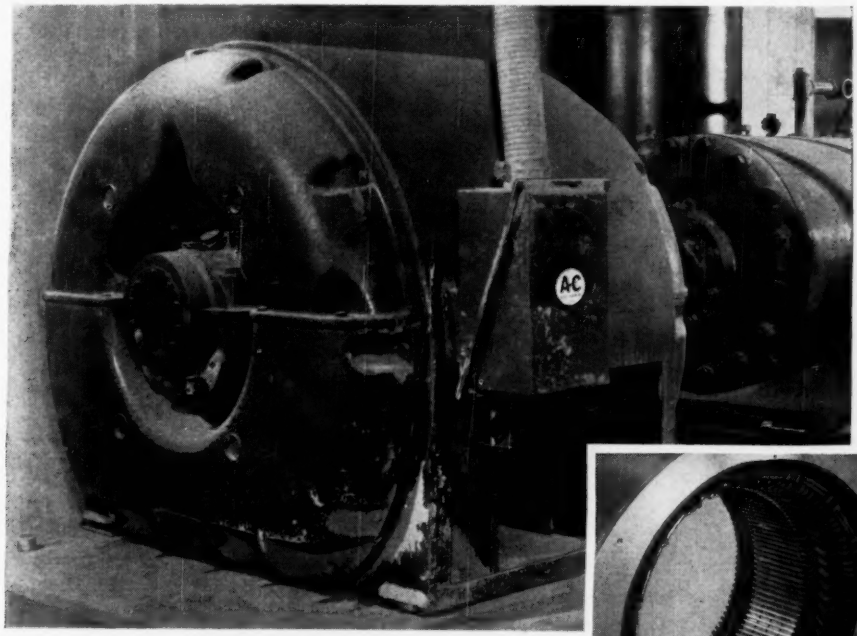
High temperature polymerization catalyst has been developed for use in the rubber silicone industries which require an initiator with a long half-life and with the ability to disassociate into a diradical. Called Luperox 2,5-2,5 it is 2,5-dimethylhexane-2,5-dihydroperoxide. — **Lucidol Div., Buffalo, N. Y. 76G**

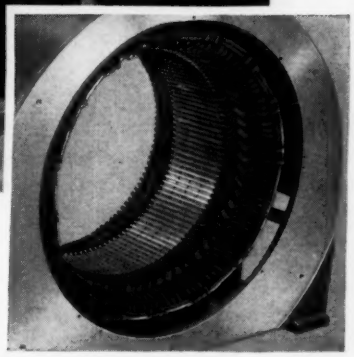
Gamma methyl- and ethyl-esters of glutamic acid are now available in pilot plant quantities. The former may be useful directly as a therapeutic agent. Both are attractive because of low price for investigational purposes and their structural similarity to glutamine. — **General Mills, Inc., Minneapolis, Minn. 76H**



Super-Seal...

motor with void-free insulation

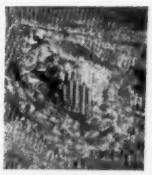




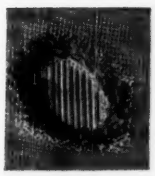
The motor that dust and dirt can't hurt



Silco-Flex Insulation



Polyester Mica Tape



Asphaltum Mica Tape

Note difference in abrasion!
Insulation shown after sandblasting for one minute with 90-grit aluminum oxide and 100-psi air from distance of six inches.

REDUCE motor clean-up frequency and schedule this downtime at your convenience by using *Super-Seal* motors in areas where there's abrasive dust and clogging dirt. These motors —

Resist abrasion: Rubbery *Silco-Flex* insulation used in *Super-Seal* motors resists the cutting action of abrasive dust particles. Unlike conventional insulations, *Silco-Flex* insulation is flexible and resilient.

Completely sealed: *Super-Seal* motor insulation is sealed against contaminants. The vulcanized void-free dielectric barrier of *Silco-Flex* insulated stator coils even resists penetration by carbon black particles.

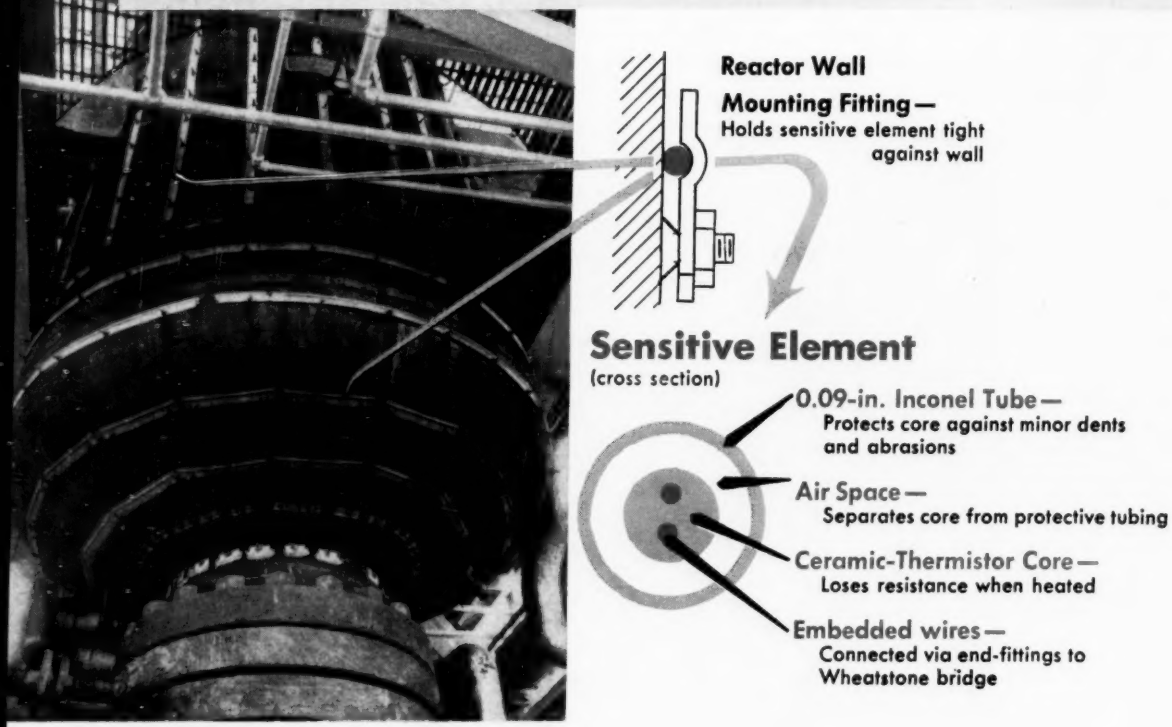
Combined with void-free *Silco-Flex* insulation are integrated mechanical features that make this motor especially suited to your toughest applications.

Get details! Call your nearby A-C office, or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

Super-Seal and *Silco-Flex* are Allis-Chalmers trademarks.

ALLIS-CHALMERS

A-5702



OVERHEAT DETECTORS mounted at Grace Chemical Co.'s ammonia synthesis plant

Airplane Overheat-Detector Goes Industrial

Thoroughly proved in flight, unique detector now protects industrial personnel and equipment.

In this age of jet planes and guided missiles, the general adaptation of industrial equipment and techniques to skycraft is commonplace. The trend is in reverse gear in one field, however—that of safety. And one of the most promising, CPI-bound offspring of aeronautical safety, is Kidde's overheat-fire detector.

Convair installs them on modern military aircraft to warn the crew of impending danger; McDonnell Aircraft does the same. Likewise, some 20 to 25 petrochemical outfits, in this country and abroad, are now using the detectors to protect synthesis-gas generation facilities and personnel.

There's nothing complicated in the construction of the Kidde detector, or in its manner of operation. Briefly, it's a closed loop of sensitive element, sometimes 100 ft. long, having a negative temperature coefficient of resistivity—it's resistance drops with rise of temperature.

One or more of these elements zig-zagged or criss-crossed around the surface of a reactor or other vital equipment, continuously monitors for overheat conditions. Danger warnings go to plant personnel either through a control box coupled to an audio or visual alarm, or via commercial recording equipment.

▶ **What's Good About It**—According to H. J. Wagner, Chief Engineer for the unit's industrial development, "The detector's outstanding feature is that it monitors the temperature every inch of the way, not just in spots like other temperature-sensing devices. As such, it picks up changes in temperatures in large zones as well as those in localized hot-spots."

Also, series connection of several sensing elements of varying coefficients of resistivity permits coverage of multi-temperature hazards.

The rugged sensing element is impervious to oil, dirt and solvents. If damaged or broken, it still continues to monitor, ex-

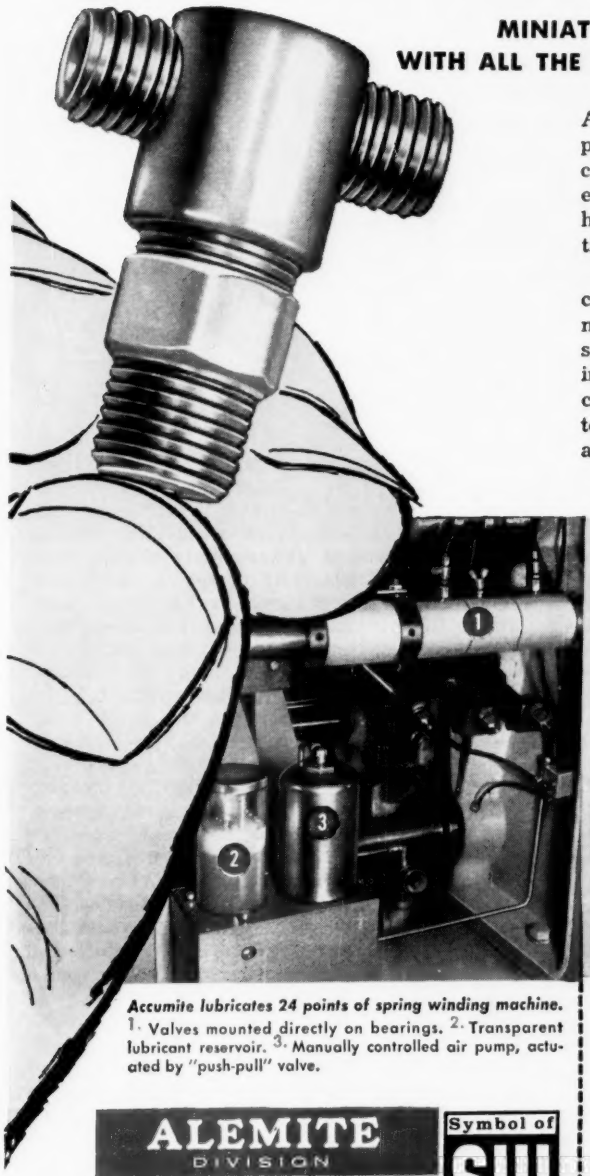
NOW! Any Machine Can Have The Advantages of Centralized Lubrication... At Low Cost!

Alemite "MINIATURE" ACCUMITE® System

MINIATURE SIZE FOR LIMITED SPACE—
WITH ALL THE QUALITY OF HIGHER-PRICED SYSTEMS!

Alemite—with 40 years of centralized lubrication experience—announces an all-new miniature system complete with pump, metering valves and controls—especially designed to service many machines and vehicles where centralized lubrication has been impractical until now!

Alemite's new midget-size Accumite system is especially adaptable to light, precision, multiple-bearing machines that have limited installation space. Its small size and simple installation overcomes cost limitations in most plants. Typical applications are: packaging, canning, labeling and textile machines . . . and machine tools. It is also suitable for tractor trailers, lift trucks and farm implements.



Accumite lubricates 24 points of spring winding machine. 1. Valves mounted directly on bearings. 2. Transparent lubricant reservoir. 3. Manually controlled air pump, actuated by "push-pull" valve.

ACCURATELY METERS THESE SHOTS OF OIL OR GREASE

.003 cu. in. .006 cu. in. .009 cu. in.

ALL THE ADVANTAGES OF "BUILT-IN" MEASURED LUBRICATION—PLUS MIDGET SIZE!

- Meters exact amounts of refinery-clean lubricants to all bearings whenever system is operated.
- Eliminates shutdown time for lubrication.
- Seals lubricant against dirt, grit and water.
- Prevents bearing troubles due to neglect or use of wrong lubricants.
- Services all bearings in one operation.
- Avoids work spoilage and bearing repairs due to over-lubrication.



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cept at the point of rupture. Even if more than one break occurs, the system functions at all points except the severed section between the breaks.

When any overheat or fire condition occurs in the monitored area, the detector sends out the warning at once—no delays caused by complex circuits or slow element response. And, after a hazard has been eliminated, the system resets automatically.

▶ **Planes, Ammonia and Power**—In addition to military jets, the detector helps to protect many a propeller-driven commercial aircraft. Vital engine areas of American Airlines' and Pan American Airlines' DC-7's are ringed with the sensitive element. So are those in TWA's 1649's. Soon, several commercial jet transports will also carry the protection.

The Kidde system first found application in planes about eight years ago. Only in the past few years has industry adopted them. But already, about 20 or 25 companies, each with one or more installations, are keeping tabs on hydrogen-producing reactors in their ammonia-synthesis plants. Reactor wall-temperatures are kept at 400-450 F. in this application; only small hot-spots along the detector elements trigger the alarm. Typical firms are the Grace Chemical Co., Memphis, Tenn.; Gonzalez Chemical Industries, Puerto Rico; E. I. Du Pont de Nemours, Newark, Del.

Another user, Public Service Electric and Gas Co., Inc. at Newark, N. J., safeguards its regenerative air heaters in steam power-generation service.

▶ **Thermistor Is the Heart**—Kidde overheat-fire detectors are temperature-sensitive systems consisting of sensing elements, controls, warning circuits and mounting fittings.

Wire-like sensing elements are mounted flush on the equipment being monitored. Actually, each element contains two wires embedded (at a fixed, closely controlled spacing) in a semi-fiexible core of thermistor-ceramic material.

Ceramic resistance decreases exponentially with temperature and linearly with length. Core is completely encased in a 0.09-in.-dia. Inconel tube. One of the embedded wires is connected to the insulated center pins of the Monel end fittings, and the other is grounded.

A hermetically sealed clearance exists between the tubing's inner wall and the core. Because of this clearance, slight dents, kinks or abrasions do not impair core efficiency.

The control box, basically a Wheatstone bridge plus a relay and power-supply circuit, continuously compares the sensitive element's resistance with fixed resistors and a potentiometer. Adjustment of the potentiometer sets the alarm's critical trip-temperature.

In operation, the core's resistance at ambient temperatures is relatively high, and current between the wires is infinitesimal. Any temperature increase, either large at one point, or small but general over the element's entire length, produces a decrease in core resistance. The bridge eventually becomes balanced at the trip point, and then normal current reverses direction. This closes the relay to actuate the system's warning circuit.

▶ **Availability**—Composition of the element's core controls the range of temperature sensitivity. A variety of core styles, calibrated for either a.c. or d.c. operation, permits overheat detection at any temperature range between 200 and 1,000 F.

Elements are available from 1-in. increments to total lengths

Equipment Developments

	Page Number is also Reader Service Code Number
Airplane overheat-detector goes industrial	78A
Frequency recorder indicates reoccurring events	82A
Weather-protected motor filters ventilating air	82B
Vacuum dryer design cuts down-time by 50%	82C
Leak-proof centrifugal and turbine pumps available	82D
Scrubber removes 99.5% of entrainment	84A
Plug-valve actuator converts valves to remote control	84B
Fork-lift attachment gives maximum lift of 12 ft	84C
High-speed fillers pack liquids or pastes	84D
Electric lift trucks operate in hazardous areas	84E
O-ring kit contains selection of sizes	84F
Tractor shovel has 2,500-lb. capacity	84G
Vertical pumps move abrasive materials	84H
Line of check valves is self-cleaning	84I
Diesel engine is smallest in its power range	84J
Centrifugal pumps feature renewal of clearance	84K
Electric cable comes in tape form	84L

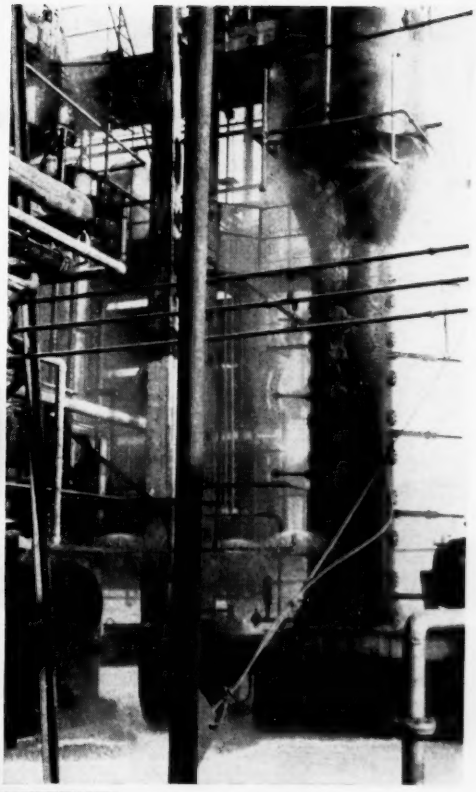
For more details, use Reader Service Card

Equipment Cost Indexes

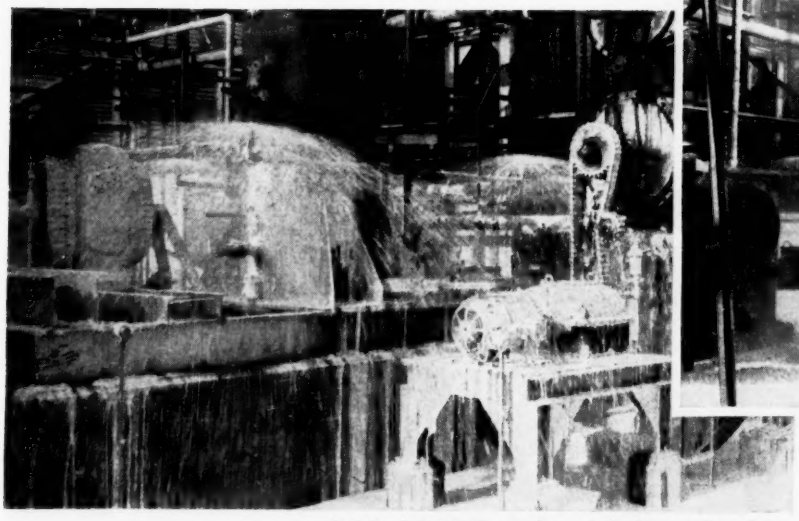
	Sept. 1957	Dec. 1957
Industry		
Avg. of all	225.0	220.7
Process Industries		
Cement mfg	216.6	220.7
Chemical	226.6	230.4
Clay products	210.4	214.4
Glass mfg	214.0	217.6
Paint mfg	217.4	221.6
Paper mfg	218.3	222.0
Petroleum ind	222.0	226.3
Rubber ind	224.8	229.1
Process ind. avg	223.7	227.0
Related Industries		
Elec. power equip	229.8	232.9
Mining, milling	228.0	231.8
Refrigerating	254.0	258.9
Steam power	212.8	216.9

Compiled quarterly by Marshall and Stevens, Inc. of Ill., Chicago, for 47 different industries. See Chem. Eng., Nov. 1947, pp. 124–6 for method of obtaining index numbers; Feb. 24, 1958, pp. 143–4 for annual averages since 1913.

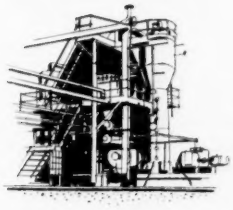
Tough Fire Protection Problem Solved by GRINNELL



▲ Grinnell ProtectoSpray on upper part of unit cools equipment and washes burning oil and solvent into area protected by foam blanket below.



▲ Grinnell ProtectoFoam safeguards the lower section of hexane solvent extraction unit with a blanket of foam, to prevent formation of explosive mixtures.



At Canadian Vegetable Oil Processing Ltd., Hamilton, Ontario, hexane solvent is used in extracting vegetable oil from soybeans. Because of the highly flammable nature of the solvent, Grinnell designed a special system for this unit, consisting of 162 ProtectoSpray nozzles — to drench the superstructure with fine water spray; and 24 ProtectoFoam spray heads — to blanket the diked area with foam. This water-foam combination protects the lives of personnel, as well as shielding equipment from costly damage.

Solving tough fire problems like this with installations engineered to the hazard, tailored to the need, built of highest quality materials is something Grinnell has been doing successfully for more than 85 years. Check the list below for the Grinnell System suited to your requirements. Or, tell us about the fire hazard you face, and let us suggest the proper installation for you. Grinnell Company, Inc., 277 West Exchange Street, Providence, Rhode Island.

Grinnell Fire Protection Systems include:

- Automatic spray sprinklers — wet pipe, dry pipe, Simplex, and deluge systems
- Emulsion and vapor dilution extinguishment with water sprays — Mulsifyre and ProtectoSpray systems
- Cooling, insulation and controlled burning with water sprays — ProtectoSpray systems
- Mechanical foam blanket — ProtectoFoam systems
- Carbon dioxide systems
- Dry chemical systems

Manufacturing, Engineering, and Installation of Fire Protection Systems since 1870

of 20 ft. A 20-ft. piece (not installed) costs about $90. Each control box goes for about $125. —**Walter Kidde & Co., Inc., Industrial and Marine Div., Belleville 9, N. J.** 78A

Frequency Recorder

Makes permanent record of operation interruptions.

Useful for both production and experimentation, the Lind-Recorder inexpensively records data relating to frequency and duration of reoccurring events.

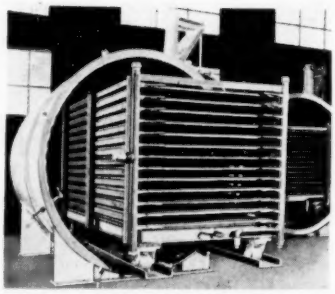
Typical applications are occurrences of an on-off, yes-no or here-there nature such as motor starts, solenoid-valve closures or overload-relay operations. Special electrically sensitive paper stores such data permanently. Paper speed in operation varies from 2 to 32 in./hr., depending on requirements.

Two instrument sizes are available—one with 68 channels, the other with 44. Lind-Recorder comes complete with power supply.—**Lindly & Co., Mineola, N. Y.** 82A



Neither Snow, Nor Rain, Nor Heat, Nor . . .

. . . Can stay operation of GE's new weather-protected motor. According to company officials, the motor "has been torture-tested in torrents of water under hurricane conditions," and exceeds the NEMA Type II definition. Special filters remove dust and highly abrasive compounds to insure that only uncontaminated air reaches the motor's working parts. Available from 250 hp. up, the motor also features ease of maintenance and attractiveness. — General Electric Co., Schenectady, N. Y. 82B



Vacuum Dryer

New tray-rack design ups capacity by 25%.

Key to the increase in drying capacity of the new Devine dryer is a 50% reduction of the unit's down time, made possible by "Roll-Away" design.

While one rack loaded with moist product rolls in, an extra rack and its load of trays containing dried product rolls away. This permits operators to unload and re-load the extra rack while the dryer is in operation. The dryer is inoperative only while loaded racks are moving into or out of it.

Each rack has 12 standard tray shelves (59 x 104 in.) spaced about 3 in. apart.—**J. P. Devine Mfg. Co., 49th St., Pittsburgh 1, Pa.** 82C

Leak-Proof Pumps

Both centrifugal and turbine models available.

Two new leak-proof canned pumps, one a centrifugal and the other a turbine type, are now available for high-temperature pumping of volatile, toxic or corrosive media.

The centrifugal model, which replaces an earlier version that has been on the market for several years, features new construction—no O-rings. The brand-new turbine model is the first and only one of its type available, officials claim.

Available from 1/6 to 1 hp., both models come in any choice of alloys or cast iron. The centrifugal model operates under line pressures up to 150 psi.; the turbine develops up to 400 psi.—**Nukem Pumps Inc., Tioga and Aramingo Ave., Philadelphia 34, Pa.** 82D

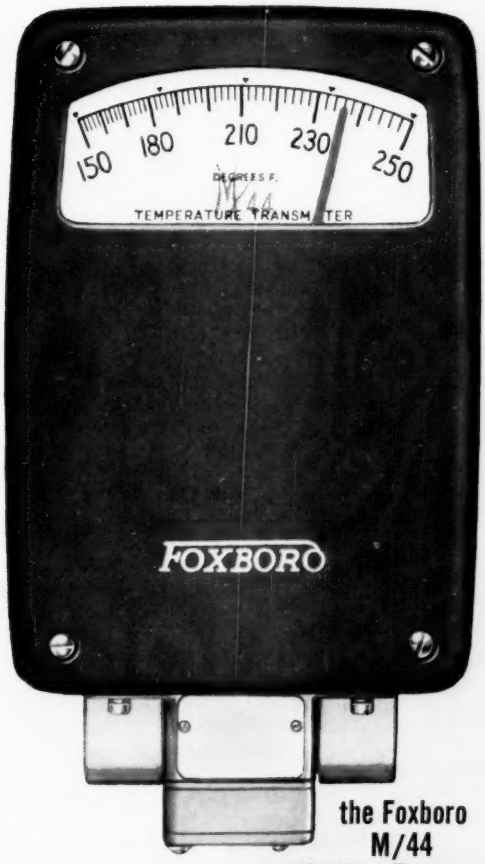
new
from
Foxboro!

a compact, low-cost

INDICATING TEMPERATURE TRANSMITTER

engineered for fast, sensitive response under roughest field conditions.

– uses any filled thermal system



the Foxboro M/44 Indicating Temperature Transmitter

Here's a brand new instrument engineered specifically for its job of indicating and transmitting temperature.

The M/44 Indicating Temperature Transmitter offers the inherent simplicity of a motion balance instrument. Compact and lightweight (10 lbs.) its indicating scale and fluorescent red pointer are visible up to 20 feet away. The output pressure of the M 44 is transmitted to any remote 3-15 psi recorder, controller, or indicator.

The M/44 is made with standard performance-proved Foxboro components, simply and conveniently arranged in a weather proof steel case. Changing range or type of thermal system can easily be done in your own plant.

Thanks to its rugged construction, the new M/44 is unaffected by vibration, sudden shock, or corrosive atmosphere. Even in the event of air supply failure, this instrument continues to indicate process temperature.

Ask your Foxboro Field Engineer about this new instrument. Or write for Bulletin 456-20A, **The Foxboro Company, 364 Neponset Ave., Foxboro, Mass.**

Choice of Thermal Systems

Foxboro M/44 Transmitters are available with any filled thermal system. These classes are suggested for particular range characteristics:

Class II Vapor Pressure (100° to 600° F)
Lowest cost, fastest response, highest sensitivity. Recommended for all installations within this range except when the measured temperature crosses ambient temperature.

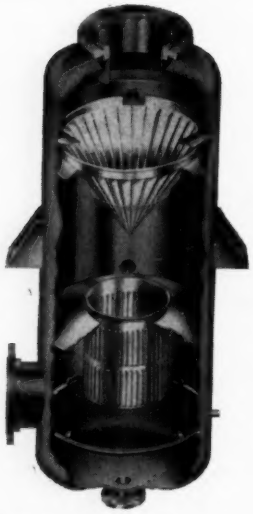
Class IA & IB Liquid Expansion (−250° to +600° F)
Good response, good sensitivity, uniform scale. Uses smallest bulb of any filled thermal system.

Class III Gas Pressure (−450° to +1000° F)
Applicable to ranges beyond the limits of other filled systems. Uniform scale. Bulb has long sensitive section; permits useful averaging measurements.

green area is actual size silhouette of the new M/44

FOXBORO
REG. U.S. PAT. OFF.

TEMPERATURE MEASUREMENT AND CONTROL



Scrubber

Designable for any flow, temperature or pressure.

The new WD Scrubber guarantees removal of 99.5% or more of solid or liquid entrainment in gas streams, regardless of particle size (1 micron or smaller). Entrainment density or chemical characteristics likewise have no bearing on scrubbing effectiveness.

In operation, contaminated gas enters the vessel and combines with sprayed scrubbing liquid. Movement through the blades of a washing tuyere imparts a rotary motion to the mixture. Centrifugal force throws the cleansing liquid plus contaminant to the walls of the scrubber.

Finally, drying action occurs as the gas plus remaining liquid passes upward through the tangential slots of a helicoid tuyere.

Contaminants removed by both tuyeres collect in raceways, and discharge through drains.—**Centrifix Corp., Cleveland 14, Ohio.** 84A

Plug-Valve Actuator

Converts valves from manual to remote control

Major advantages claimed by the rugged Robotarm Valve Actuator include ease of installation, compactness and low-cost. Operated by either gas or fluids, the actuator provides remote control of plug valves and other wrench-operated, 90-deg. rotating mechanisms.

Field installation, which doesn't disturb existing valve setting, takes only minutes. Place the Robotarm over the valve, having first installed the proper adaptor bushing, and secure the adjustable mounting bracket to the process line. Special tools are not required.

When supplied with an operating pressure of 100 psi., standard models generate 3,000 to 25,000 in.-lb. of torque; special Robotarms are available for higher torques or gear-head valves.—**Research Engineering Co., Houston, Tex.** 84B

BRIEFS

A new fork-lift attachment, the Triple Lift Mast, gives the Towmotor Model 460 truck a maximum lift of 144 in. Lowered mast height is only 71 in.—**Towmotor Corp., Cleveland, Ohio.** 84C

Two high-speed fillers: Model 15 NH2, having a filling range of ¼ oz. to 1 gal., packs 10 to 60 containers/min. of liquids or pastes. Type RC 1210 loads ⅛ to 2-oz. containers at speeds up to 200 per min.—**Hope Machine Co., 9400 State Rd., Philadelphia 14, Pa.** 84D

Electric lift trucks for operation in Class I Group D, and Class II Group G explosion-hazard areas are available in capacities up to 6,000 lb.—**Revolvator Co., Tonnelle Ave., North Bergen, N. J.** 84E

O-ring selection kit contains 180 rings in sizes ranging from 1 to 25. A gage in the side of the carrying case measures ring cross-sectional thickness. — **Bearings Inc., 3634 Euclid Ave., Cleveland 15, Ohio.** 84F

An industrial tractor shovel, with 2,500-lb. carrying capacity and a 6-ft. dumping clearance, marks the entry of Yale into the bulk materials-handling field.—**Yale Materials Div., Yale & Towne Mfg. Co., Philadelphia, Pa.** 84G

Vertical self-priming pumps for removing abrasive materials from sumps is available in three sizes from 1½ to 6-in. suction and discharge.—**Allen-Sherman-Hoff Pump Co., 259 E. Lancaster Ave., Wynnewood, Pa.** 84H

Line of 4,000-psi. spring-loaded check valves, especially designed for oil or raw water service, affords excellent resistance to corrosion. Self-cleaning, they come in sizes ranging from ¼ to 2 in. NPT. —**Sinclair-Collins Valve Co., 454 Morgan Ave., Akron 11, Ohio.** 84I

New turbo-supercharged diesel engine, in sizes up to 3,600 hp. is claimed to be the smallest and lightest commercial diesel in its horsepower range. In addition to weight savings, turbocharging reportedly cuts 5-10% off the fuel bill.—**Fairbanks, Morse & Co., Beloit, Wis.** 84J

New line of centrifugal pumps features a recirculation port designed to permit rapid priming and renewal of internal clearance. Manufactured with 1½ to 8-in. suction and discharge.—**Worthington Corp., Harrison, N. J.** 84K

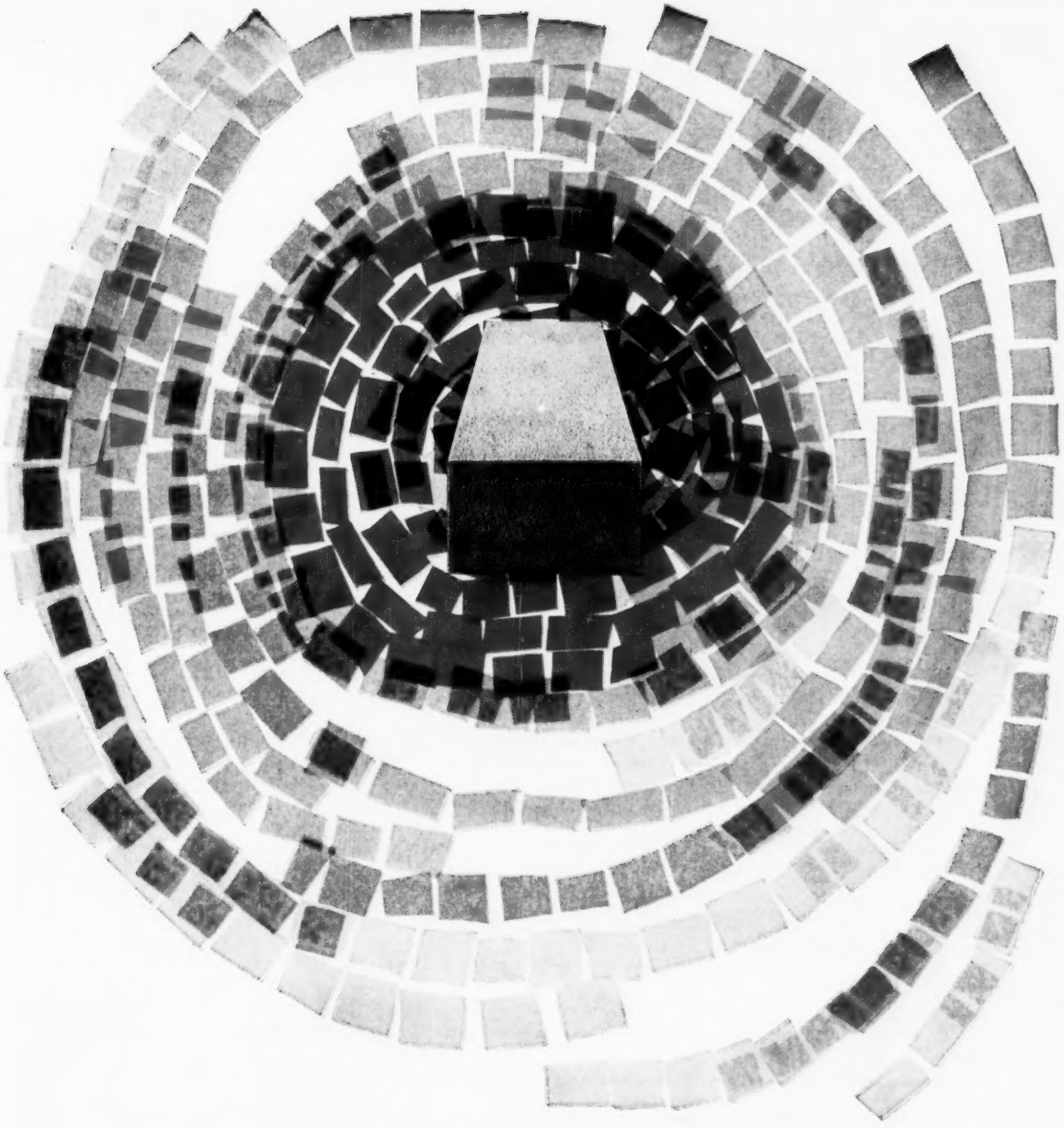
Multiconductor electrical tape cable, which is 80% lighter than conventional cable, comes in widths up to 51 conductors. Each conductor has a 1-amp. rating.—**International Resistance Co., 401 North Broad St., Philadelphia 8, Pa.** 84L

For More Information . . .

about any item in this department circle its code number on the

Reader Service

postcard (p. 225)



mix imagination with Alcoa Aluminas

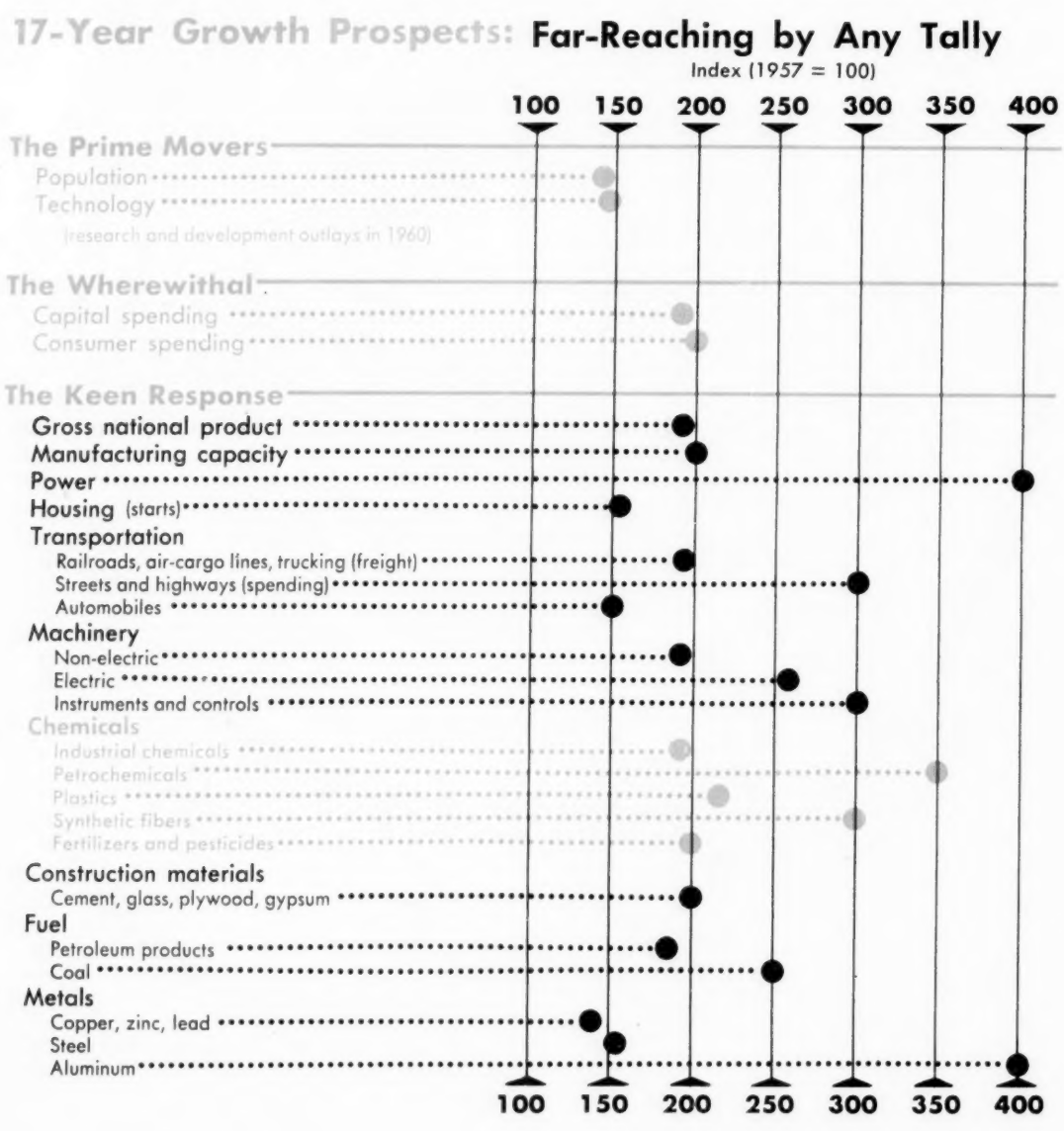
and get refractories or refractory castables that work hardest, longest! Refractories are vital to production in almost every industry. To give industry the best refractories possible, more and more refractory manufacturers have turned to Alcoa® Aluminas. They've found that refractoriness and durability increase in direct proportion to the amount of alumina they use. They know it pays to mix imagination and engineering with Alcoa Aluminas . . . for the best in refractory performance at reasonable cost.

Alcoa is not a source for finished refractories, but does supply aluminas to manufacturers of the best refractories. For their names, write: ALUMINUM COMPANY OF AMERICA, CHEMICALS DIVISION, 702-D Alcoa Building, Pittsburgh 19, Pennsylvania.

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"ALCOA THEATRE"
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Alternate Monday Evenings



American Economy in 1975: Twice As Big!

After a long winter of recession, how about some spring tonic, a look ahead? The view is terrific.

Asst. Secretary of Commerce Frederick Mueller, in a recent talk, described the present business slump as " . . . the best advertised recession in history."

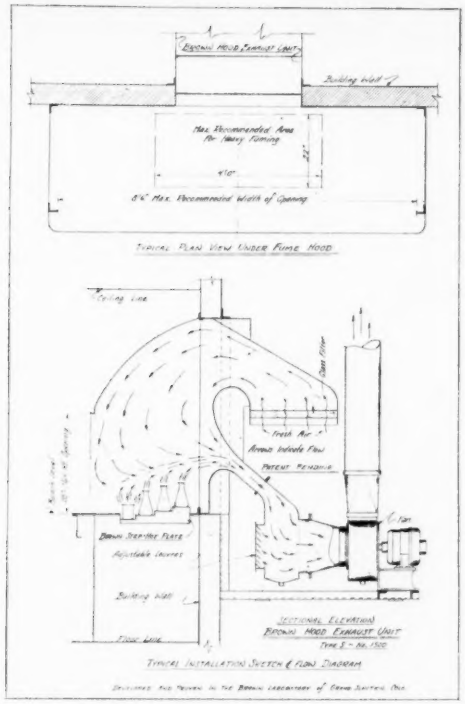
This writer thinks Mueller said a mouthful. In that sentence fragment was the implication that overemphasis of the most negative aspects of the current recession is doing no one much good (except to win votes and encourage shotgun handouts).

Mueller went on to suggest, less subtly, that efforts to bolster public confidence would be more beneficial, more truthful.

An outlook for the American economy just prepared by the McGraw-Hill Dept. of Economics falls in this latter cate-

DO YOU HAVE FUME PROBLEMS . . .

And the subsequent heating, conditioning and corrosion factors to make it all the more complex? Then take a look at this revolutionary principle and design.



Typical Plan View Under Fume Hood

Sectional Elevation Brown Hood Exhaust Unit Type E - No. 1500

Typical Installation Sketch & Flow Diagram

Developed and Proven in the Brown Laboratory of Fume Control, Inc.

• • • • • This typical installation and flow diagram illustrates the simplicity with which the problem is handled by the

BROWN HOOD *Exhaust* UNIT

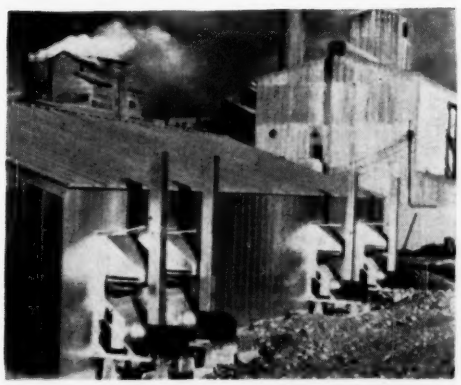
• This unit was designed primarily for the laboratory, but one may readily visualize this apparatus taking care of many other industrial applications. In educational institutions it serves well in both the laboratory and the shop where welding is done. Assuming conditions do not fit this particular design, we render a design service to cope with YOUR problem.

The BROWN HOOD EXHAUST UNIT is self contained and, functioning as it does to provide its own source of fresh air for fume removal, it is no longer necessary to use massive air conditioning apparatus—as the season may demand—to heat or cool the laboratory. With the installation of the BROWN HOOD EXHAUST UNIT it is necessary to provide only for normal air changes.

The foremost considerations in the design of this UNIT were the dual purposes of fume removal and prevention of corrosion in critical areas where contamination of the work being processed was a primary factor. The above flow diagram shows how this is accomplished by providing a heavy blanket of fresh and filtered air continuously flowing at low velocity across the under confines of the hood, thus forming an effective and efficient barrier against corrosion in this area where "sluffing" from above contaminates samples being processed.



Photograph shows the BROWN HOOD EXHAUST UNIT in operation with an effective way of indicating the efficiency and effectiveness of the principle of operation.



Photograph shows an installation in the laboratory of one of the large Uranium Mills.

Note also the clean-cut, unobstructed areas from the throat of the apparatus and on to the fan. This facilitates washing down of possible accumulations of salts such as perchlorates, a number one hazard in the laboratory.

This design is applicable to almost any "along-the-wall" hood installation and requires only the opening for its placement and outside supports.

THE BROWN LABORATORY

HOOD DIVISION

2263 BROADWAY GRAND JUNCTION, COLORADO

gory.* This prophetic survey says that, barring only the worst calamities — hydrogen bomb wars, attacks from flying saucers, mass sterility or the upheaval of both our republican form of government and our capitalistic system—we will enjoy an economy in 1975 nearly twice as big as the one today.

Most of the numerical measures of this tremendous, and highly credible, growth potential are charted above (see p. 86). So let's deal here with a few of the more qualitative ap-



praisals of what life may be like in the U. S. in twenty years.

▶**Babies and Space**—Next to more and more babies, our economy's biggest growth stimulus comes from the doubled and redoubled research and development efforts by government and industry. Research which is carrying us headlong into, for instance, the space age—into problems of propulsion, structure, guidance, re-entry, instrumentation, power supply, test facilities, launching sites, tracking and communication, space biology and psychology.

What fruit these efforts will bear in space itself in twenty years is hard to figure. But, as McGraw-Hill's survey points out, advances in chemistry, electronics and metallurgy made in the exploration of space—and the mighty vote of confidence Sputniks I and II gave the scientist and a scientific education—will pay off in countless industrial applications on this old world.

▶**Ease via Mechanization**—



Space age notwithstanding, mechanization will make greater inroads in laborious fields like agriculture and construction. Food processing plants may take raw materials right from the harvesters in one continuous operation. Bigger construction equipment will haul factory-made sections of walls and floors into place—for giant office buildings as well as for homes.

Mechanization will show up more in mining, too, in the shape of more equipment to cut and handle coal in a continuous stream from seam to surface. (Or maybe coal will be gasified underground and piped directly to the plant site for power generation or chemical synthesis.)

▶**Choice via Prefabrication**—Prefabrication will make it possible to turn out standard, low-cost housing much as we now produce cars—make it possible to remodel, alter or add to existing houses as the needs of our families change. Style changes in housing—perhaps via trade-ins of sections or complete structures—may become as frequent as model changes in autos.

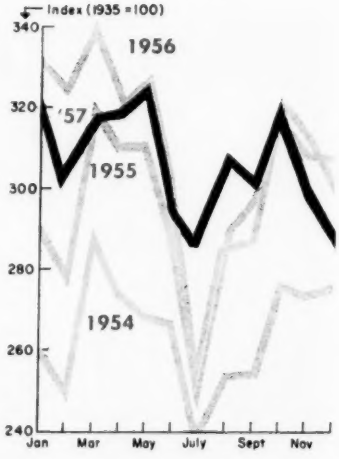
Many people will own two homes in 1975, one a prefabricated cottage or cabin in a resort area—and at least one car in each place. In fact, an automobile and electric appliances may well be included in a package deal for the man who buys a prefabricated country home. Most new homes in 1975 will be completely air conditioned year-round, and electrically heated in winter via a heat pump or resistance devices.

To gratify the inner man: Delicacies prepared by French chefs brought nearly fresh to American tables by advanced techniques of food preservation, packaging and transportation. And our own chemical industry may be synthesizing some foods at a lower cost than the farmer can grow it.

▶**Faster and Further**—A good many families will own a helicopter in 1975. And nearly everyone will be using whirly birds for shorter trips, much as they ride buses today. For longer trips people will travel in greater comfort and at greater speed in lightweight railroad cars and jet planes.

And for those seeking to pioneer rather than pleasure-cruise, the American Rocket Society holds out this promise: Manned-satellite flights around the world in ten years, trips around the moon in fifteen, and flights to the moon, including landing (and, we trust, taking off again), in about 20 years.

Chemical Consumption



Consumption by Industries

	Nov. (Final)	Dec. (Est.)
Coal products	10.2	9.3
Explosives	10.0	9.8
Fertilizer	68.7	70.3
Glass	25.3	23.8
Iron & steel	15.4	13.6
Leather	4.1	4.1
Paint & varnish	27.3	23.0
Petroleum refining	30.1	31.5
Plastics	25.5	24.3
Pulp & paper	37.3	32.4
Rayon	27.2	26.8
Rubber	6.6	5.8
Textiles	9.4	8.0
Total	297	283

* "The American Economy—Prospects for Growth (1957-1965-1975)."

News and Notes on...

Good Packing Practice

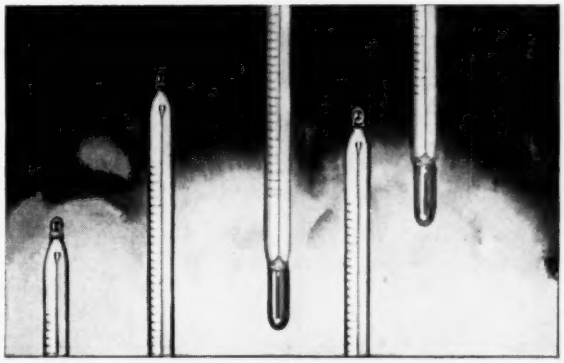
JOHNS-MANVILLE JM PRODUCTS

Maintenance and Design Hints from Johns-Manville Packings and Textiles Dept.

Subject of the month: High Operating Temperatures

Question:

What sealing materials are currently available that will match conditions brought about by higher and higher operating temperatures?



Condition 1

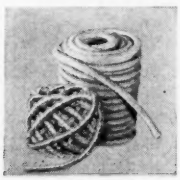
FOR LASTING VALVE SEALS AGAINST SUPERHEATED STEAM AND DRY GASES



Designed to meet today's demand for a packing that will maintain a tight seal against steam and dry gases on valves working at line temperatures up to 1200F, J-M High-Temperature Valve Stem Packing, Style 397, offers the three-way protection of a heat-resistant plastic core, asbestos yarn, and Inconel wire reinforcement. For lasting protection of valve stems during storage, this efficient packing is now available with J-M No. 9 corrosion inhibitor.

Condition 2

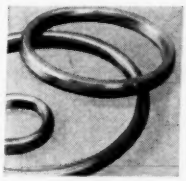
FOR UTILITY SEALING IN GENERAL APPLICATIONS REQUIRING HEAT AND FLAME RESISTANCE



Wherever your operation calls for a utility gasketing material that withstands both heat and flame, specify J-M Asbestos Rope, Style 4200. Made of 99% pure asbestos, this material can take temperatures far in excess of other grades of rope. You'll find it a handy, reliable gasket for sealing joints between furnace doors and brickwork, boiler expansion joints, blast furnace connections, ingot moulds, and countless other uses. Ask for information about J-M Style 4200 Asbestos Rope.

Condition 3

FOR FLANGES WORKING AT TEMPERATURES TO 1600F AND HIGHER



Elevated temperatures are efficiently sealed using J-M Goetze V-Tite Gaskets. Used in flanges grooved for ring joint gaskets. Materials are available for service ranging upwards of 1600F. Controlled hardening assures correct flow of material at low bolt stress. Temperature range —320F to +1600F and higher.

Condition 4

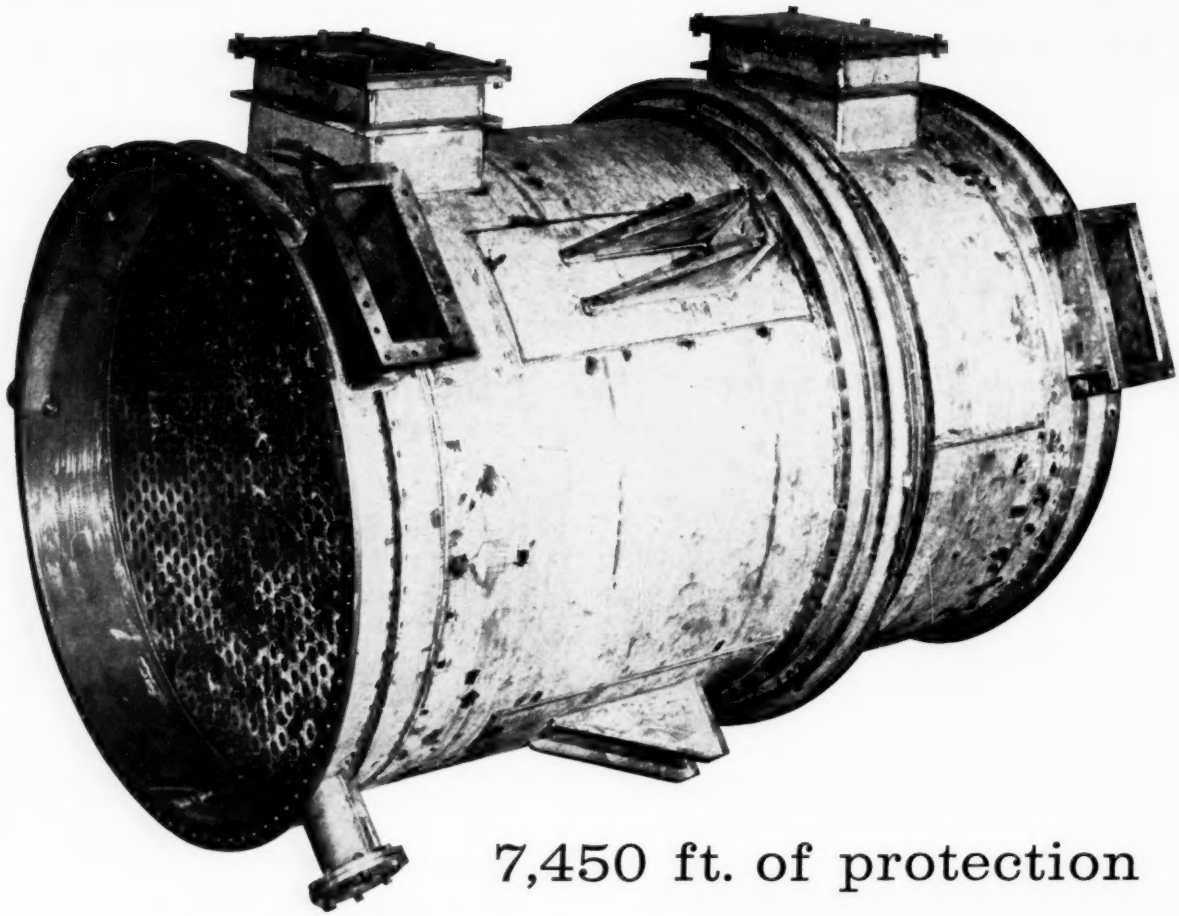
FOR PACKING PROBLEMS IN ANY TEMPERATURE RANGE



Your Johns-Manville field representative is a trained specialist in packing problems of all types. He's located near you, to help out whenever you need specialized packing information. For information on new packings and gaskets—for engineering and design advice—for tips on more efficient, more economical packing techniques—your Johns-Manville representative is a good man to know.

For information on any Johns-Manville Packings and Gaskets, write Johns-Manville, Box 14, New York 16, N. Y. In Canada: Port Credit, Ontario.

JOHNS-MANVILLE



7,450 ft. of protection from 1000°F chemicals provided by Carpenter Welded Stainless Tubing

• One of the largest ever built, this vertical heat exchanger is used by a leading chemical company as a chemical converter operating at temperatures up to 1000°F. It measures 7½ ft. in diameter by 10 ft. high. The tubes, tube sheets and bonnets are all of Type 321 stainless steel. They convey a highly corrosive chemical catalyst.

The consistent quality and greater uniformity of Carpenter Stainless Tubing are influential factors in its selection for more and more critical applications.

Carpenter delivers these advantages plus the biggest extra of all . . . lower initial cost.

All 40 types of Carpenter Stainless Tubing can deliver these benefits. Contact your local distributor for some solid "how" and "why" information or write for TD 120, Carpenter's newest Selecting and Buying Guide. The Carpenter Steel Company, Alloy Tube Division, Union, N.J.

MEMBER

Export Dept.: The Carpenter Steel Co., Port Washington, N. Y.—"CARSTEELCO"

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Stainless Tubing & Pipe

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U.S.I. CHEMICAL NEWS

April ★ A Series for Chemists and Executives of the Solvents and Chemical Consuming Industries ★ 1958

ISOSEBACIC® Acid Process Covered by 8 U.S.I. Patents

Synthesis of U.S.I.'s new intermediate for the plastics industry, ISOSEBACIC Acid, is detailed in a series of eight patents issued on December 17 of this past year to Dr. Charles E. Frank and other members of the company's research laboratories. Dr. Frank is discussing the material contained in these patents before the alkali metals symposium at the ACS meeting in San Francisco this month.

The new intermediate is a mixture of sebacic acid, 2-ethylsuberic acid and 2.5-diethyladipic acid – the latter two compounds being relatively unknown until the development of this synthesis. Here are the patent numbers and the subjects they cover:

USP 2,816,913—Preparation of Substituted Acids
USP 2,816,914—Dimerization Process
USP 2,816,916—Dimerization Process
USP 2,816,917—Selective Process for Dimerization of Unsaturated Hydrocarbons
USP 2,816,918—Carbonation Method
USP 2,816,919—Method of Preparing Acyclic Carboxylic Acids
USP 2,816,935—Process for the Preparation of Alkali Metal Derivatives of Conjugated Diolefins and Vinyl Aromatic Compounds
USP 2,816,936—Process for Formation of Dialkali Metal Dimers of Diolefins

A plant to produce ISOSEBACIC Acid in commercial quantity is now starting up at U.S.I.'s major chemical complex in Tuscola, Illinois. Potential applications of the new intermediate include the manufacture of plasticizers, ester lubricants, alkyds, polyamides, polyurethanes, reinforced plastics and in chemical synthesis.

New Motor Pump Designed To Move Liquid Metals in Nuclear Power Reactors

A new type of pump has been developed to circulate liquid metal coolants such as sodium and sodium-potassium (NaK) at high temperature through hermetically sealed systems in nuclear power plants.

The prototype for the new pump was tested at temperatures up to 1,265°F. After 3,500 hours of operation at temperatures constantly above 1,000°F., inspection showed all parts of the pump to be in excellent condition.

Since some liquid metals are not only chemically active but also become radioactive when used as coolants in nuclear reactors, the liquid metal pump is hermetically sealed to make it leak-proof. It can be obtained in capacities ranging from 150 to 5,000 gallons per minute at operating temperatures up to 1,600°F.

The operating temperature of the new pump motor is said to be independent of the temperature of the liquid metal being circulated, permitting operation in reactor systems where temperatures are even higher than the 1,265°F used in testing.

Other equipment for handling liquid sodium is discussed in a booklet entitled "Handling Liquid Sodium" which is published by U.S.I.

Mallory-Sharon Zirconium Plant Comes Onstream at Ashtabula, O.

2,000,000 Pound-Per-Year Plant Also Produces Hafnium

The new Mallory-Sharon Metals Corporation is owned one-third each by National Distillers, P. R. Mallory and Sharon Steel. Zirconium sponge and platelets are now in production at the company's new plant in Ashtabula, Ohio.

Half the output of the installation is committed for the next five years under contract with the Atomic Energy Commission. The balance is available to industry in both commercial and reactor grades for nuclear work as well as for structural use where high corrosion resistance is desired.

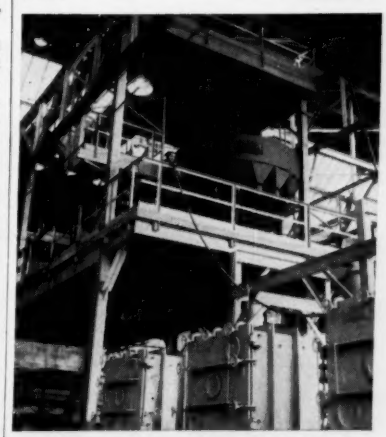
Hafnium tetrachloride, oxide, sponge and platelets are also produced as an adjunct to the zirconium operation. Hafnium, because of its ready absorption of neutrons, makes excellent control rod material in reactor cores. It is in fact used for that purpose in the Shippingport installation now delivering electricity to the commercial grid of the Duquesne Light Co.

Sodium Reduction Process Employed

The new plant is the first to make zirconium sponge and platelets employing semi-continuous production techniques developed by the U.S.I. research group. These techniques involve the use of sodium as the reducing agent for zirconium tetrachloride, and yield sponge of greater purity as a result. The method, which is also being applied to other metals such as hafnium and titanium, tantalum and columbium (niobium), has the advantage over other processes of a lower initial investment cost.

Mallory-Sharon Metals has been granted an exclusive license to use this process. The sodium for the process comes from the U.S.I. sodium operation three-quarters of a mile from the new plant.

MORE



Part of the processing equipment at the Mallory-Sharon Metals zirconium plant, now onstream at Ashtabula, Ohio.

Moffett Becomes Assistant Sales Manager for U.S.I. Polyethylene Resins

John K. Moffett, Jr. has been appointed as Assistant Manager of PETROTHENE® Polyethylene Sales at U.S.I. Mr. Moffett graduated from Yale in 1948 and has been employed since that time by U.S.I. in various capacities. He was supervisor of the company's sodium peroxide plant, head of sodium peroxide sales, and at the time of his new appointment was in a sales development position for U.S.I. PETROTHENE polyethylene resins.



U.S.I. Building Tantalum-Columbium Pilot Plant

U.S.I. is constructing a pilot plant to produce tantalum and columbium metals in Cincinnati, Ohio, site of the U.S.I. Research Laboratories. Part of the same facilities that were employed for piloting zirconium and titanium will be used in the new pilot unit, which is expected to be onstream shortly.

Capacity of the pilot plant will be one ton of combined metals per month on a one shift per day basis, three tons per month on a round-the-clock basis. The two metals will be produced in approximately equal quantities although variations of from 10% tantalum up to 60% tantalum are possible, depending upon the ore used.

The tantalum and columbium (also called niobium) will be produced by a U.S.I.-developed sodium reduction process. A sodium reduction process is in use at the Ashtabula, Ohio zirconium plant of Mallory-Sharon Metals, which is one-third owned by U.S.I.-National Distillers. A related process will also be used in the Mallory-Sharon titanium plant now under construction at Ashtabula.

Pilot operation and initial market development programs for tantalum and columbium will be undertaken by U.S.I. independently of its association with Mallory-Sharon Metals. However, it is expected that any commercial facilities to be built after the pilot plant pro-

MORE

April ★ **U.S.I. CHEMICAL NEWS** ★ 1958

CONTINUED

Zirconium Plant

Zirconium Platelets Non-Pyrophoric

Reactor and commercial grades of zirconium are being supplied by Mallory-Sharon Metals in the form of sponge, platelets, unalloyed zirconium and zircaloy ingots and mill products. Platelets—irregular, flake-like pieces about the size of dimes, and quarters—are non-pyrophoric and non-hygroscopic. They insure greater safety during handling and shipping. They can be compacted for melting as easily as sponge and with virtually no waste. They are of extremely high purity, being almost completely free of sodium, magnesium, chlorides, hydrogen and moisture.

Zirconium Role in Reactors

Reactor-grade zirconium is essential as structural material for atomic reactors and for cladding uranium because of its ability to let neutrons pass through, thereby permitting maximum fuel efficiency of the reactor. Zirconium also has extremely high corrosion and heat resistance, vital to atomic energy applications. Hafnium, always found associated with zirconium in the natural state, must be removed in an extra refining step in the manufacture of reactor-grade material, because of its neutron-trapping properties. Hafnium does not interfere with zirconium's corrosion resistance, however.

Zirconium Role in Chemical Industry

Commercial-grade zirconium, with 1-3% hafnium content, shows great promise for the chemical process industries. It has excellent resistance to acids, alkalies, chlorine and chlorides, corrosion and heat, combined with strength, ductility, light weight and good machining properties.

CONTINUED

Pilot Plant

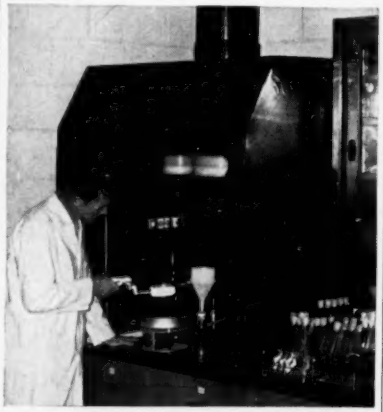
gram is completed, will be owned by Mallory-Sharon Metals.

Primary market for tantalum is expected to be the chemical process industries where it has long been used because of its chemical inertness, especially to hydrochloric acid.

Columbium, or niobium as it is often called, has been in demand as an alloying material for steel. More recent interest in this metal stems from its properties of low neutron cross-section, high-temperature strength, high melting point and the insolubility of columbium oxide in the metal at elevated temperatures. This combination of properties makes it a material with considerable promise for nuclear applications, including gas-cooled atomic reactors, as well as certain applications in supersonic aircraft and gas turbines.

Black Polyethylene Used For Ventilating Systems In Chemical Laboratories

Ventilating systems for laboratories, which will withstand corrosive fumes without deteriorating or discoloring, are now being fabricated completely of black, all-weather polyethylene. Since polyethylene compounded with black is expected to give 15 to 20 years of service, its substitution for metal should reduce maintenance and replacement problems substantially on fume hoods, exhaust stacks, fans and fittings.



Black polyethylene fume hood and stack exhaust acid vapors without deteriorating, cut replacement costs (photo courtesy American Agile).

TECHNICAL DEVELOPMENTS

Information about manufacturers of these items may be obtained by writing U.S.I.

For corrosion studies, two special solutions are now offered which isolate surface films from metals. An iodine-methanol solution is designed for aluminum alloys containing no copper, an iodine-methanol sulfosalicylic acid solution for aluminum-copper alloys. **No. 1340**

New 24-page booklet on titanium—includes physical and mechanical properties, metallurgy, corrosion resistance, methods of machining, forming and welding. **No. 1341**

Atomic lamps said to provide power-free, uninterrupted light for up to 10 years have been developed. They use radioactive krypton—85 gas to excite specially processed, hermetically sealed phosphor crystals. **No. 1342**

Cost of polyurethane installations foamed-in-place can be estimated with a nomograph chart now available. Thickness, area, density of stock and price per pound must be known. Chart eliminates need for calculation. **No. 1343**

Concentrated (98%) ethylene diamine can now be obtained in commercial quantities for use by manufacturers of textile finishing and polyamine resins, synthetic waxes, rubber chemicals, fungicides, pharmaceuticals. **No. 1344**

New polyethylene-to-metal adapter has been devised to connect polyethylene and metal pipes and fittings without using clamps. It consists of a threaded polyethylene gasket between metal nut and tailpiece. **No. 1345**

4,4'-Diaminostilbene is available in laboratory quantity. It is readily soluble in methanol and ethanol, sparingly soluble in carbon disulfide, benzene, hot water. Forms azo dyes, useful as organic intermediate. **No. 1346**

Ten new atomic models for constructing organic metal chelates are now on the market. They are scaled to a magnification of 1.5 X 10^8. Four models represent the central metal atoms. Others used for rest of chelate. **No. 1347**

New silicone fluid of low viscosity has been introduced for use as a damping medium and hydraulic fluid. Is claimed to have lower viscosity-temperature coefficient and lower pour point than most methyl silicone fluids. **No. 1348**

Pyroglutamic acid (L-2-pyrrolidone-5-carboxylic acid) is now offered in pilot plant quantities. This heterocyclic amino acid has 2 reactive positions—a carboxyl and a cyclic amide group. Suggested as intermediate and for resolving racemic mixtures of amines. **No. 1349**

PRODUCTS OF U.S.I.

Alcohols: Ethyl (pure and all denatured formulas); Proprietary Denatured Alcohol Solvents SOLOX®, FILMEX®, ANSOL® M, ANSOL PR.

Organic Solvents and Intermediates: Normal Butyl Alcohol, Amyl Alcohol, Fusel Oil, Ethyl Acetate, Normal Butyl Acetate, Diethyl Carbonate, DIATOL®, Diethyl Oxalate, Ethyl Ether, Acetone, Acetoacetanilide, Acetoacet-Ortho-Chloranilide, Acetoacet-Ortho-Toluidide, Ethyl Acetoacetate, Ethyl Benzoylacetate, Ethyl Chloroformate, Ethylene, Ethyl Sodium Oxalacetate, Sodium Ethylate, ISOSEBACIC® Acid, Sebacic Acid, Urethan U.S.P. (Ethyl Carbamate), Riboflavin U.S.P.

Pharmaceutical Products: DL-Methionine, N-Acetyl-DL-Methionine, Urethan USP, Riboflavin USP, Intermediates.

Heavy Chemicals: Anhydrous Ammonia, Ammonium Nitrate, Nitric Acid, Nitrogen Fertilizer Solutions, Phosphatic Fertilizer Solution, Sulfuric Acid, Caustic Soda, Chlorine, Metallic Sodium, Sodium Peroxide, Sodium Sulfite, Sodium Sulfate.

PETROTHENE® Polyethylene Resins

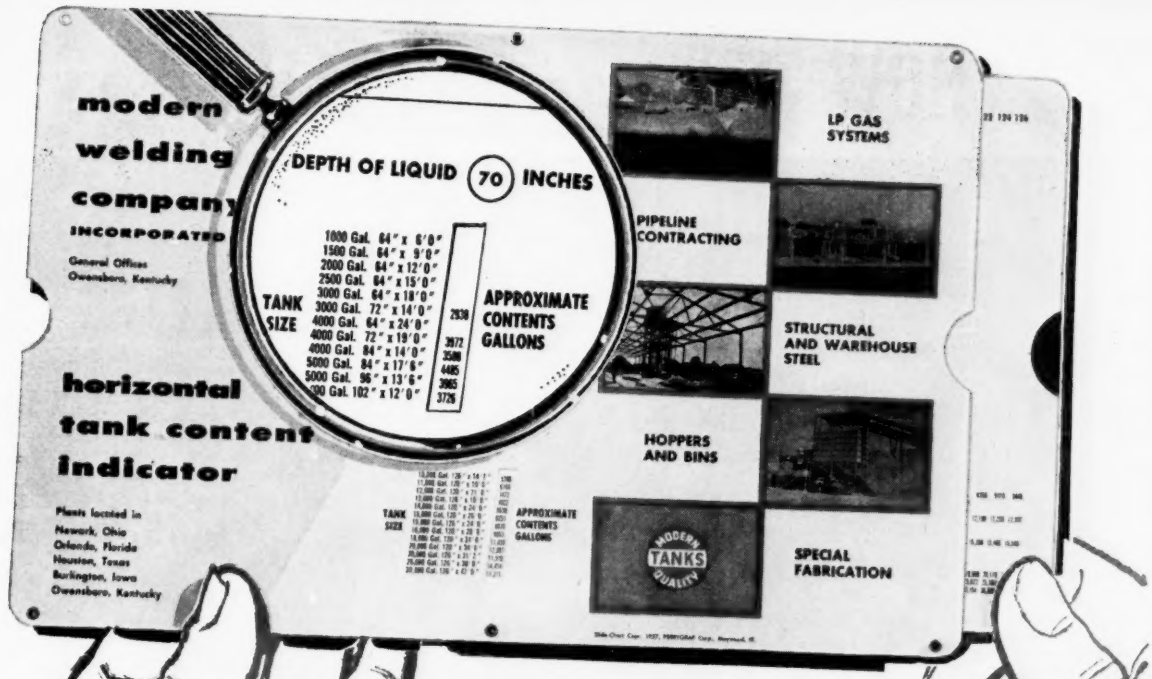
Development Chemicals: Ethylaluminum Sesquichloride, Methylaluminum Sesquichloride, Monomethyl Hydrazine, Triethyl Aluminum, Trimethyl Aluminum, Unsymmetrical Dimethyl Hydrazine.

Animal Feed Products: Antibiotic Feed Supplements, BHT Products (Antioxidant), Calcium Pantothenate, Choline Chloride, CURBAY B-G®, Special Liquid CURBAY, VACATONE®, Menadione (Vitamin K_3), DL-Methionine, MOREA® Premix, Niacin USP, Riboflavin Products, Special Mixes, U.S.I. Permadry, Vitamin B_{12} Feed Supplements, Vitamin D_3, Vitamin E Products, Vitamin E and BHT Products.

U.S.I. INDUSTRIAL CHEMICALS CO.
Division of National Distillers and Chemical Corporation
99 Park Avenue, New York 16, N. Y.

U.S.I. SALES OFFICES

Atlanta • Baltimore • Boston • Buffalo • Chicago • Cincinnati
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Yes, efficient storage is our business:

And efficient storage includes accurate inventories. To help you with these records, a new **"Modern Liquid Computor"** is available *absolutely free.* There are many other ways **Modern** can help you plan for more efficient and economical storage. Just write or phone. A **Modern** representative will "come a-runnin'".

MODERN TANKS QUALITY

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INCORPORATED
1500 EAST 12th STREET
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BURLINGTON, IOWA
HOUSTON, TEXAS
NEWARK, OHIO
ORLANDO, FLORIDA

Modern Welding Company, Inc.
1500 East 12th Street
Owensboro, Kentucky

Please mail, absolutely free, **"The Modern Liquid Computor".**

Have your representative call: _____ (Date)

NAME: _____

COMPANY NAME: _____

ADDRESS: STREET _____ CITY _____

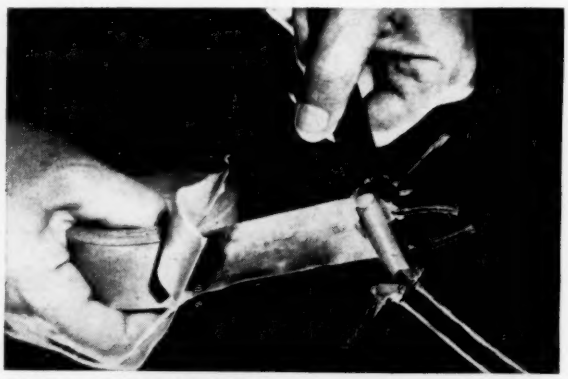
HOW *HERCULES* HELPS...



MAINTAIN QUALITY STANDARDS—For generations "Evenflo" baby bottles have been a recognized leader in their field. Now Pyramid Rubber Company uses Hercules Hi-fax® high density polyethylene to mold "Evenflo" plastic bottles with even more advantages. Unbreakable, of course, Hi-fax bottles are acceptable by FDA for direct contact with food, can withstand the high temperatures necessary for sterilization. These are just a few reasons why Hi-fax is finding ever increasing use in packaging, toys, fabrics, wire coating and pipe.



ENCOURAGE YOUTH—Pictured with Hercules Vice President Paul Mayfield are winners in the National 4-H Entomology Awards Program. Agricultural Chemicals Division thus plays a part in the development of farm and civic leadership.



CREATE NEW PRODUCTS—Rubber and Asbestos Corporation depends on two Hercules tackifying agents for the unique characteristics of its new "Tackmaster" pressure-sensitive film used in the tape shown. The Hercules materials help provide the high tack, quick stick and grab necessary in such films, plus easy separation from the protective release paper.

HERCULES POWDER COMPANY
INCORPORATED
900 Market Street, Wilmington 99, Delaware

G58-2

CHEMICAL MATERIALS FOR INDUSTRY

HERCULES



How To STOP SLURRY VALVE FAILURE

Rockwell-Nordstrom valve's "clean-as-a-whistle" flow passages eliminate packing by slurries and eventual valve failure from corrosion of exposed seats.

The Problem: Valve failure on green liquor slurry service at a southern paper plant was becoming increasingly costly in terms of lost production time and high maintenance costs. Suspended solids settled out of the solution and packed into the valve cavities . . . soon the valves wouldn't close and corrosive fluids attacked the exposed metal-to-metal seats.

Solution: Comparative performance tests proved that Rockwell-Nordstrom lubricated plug valves eliminated the packing problem and that shut-off remained absolutely positive. The smooth, cavity-free flow passages in these valves can't trap suspended solids. Also, seating surfaces are never exposed to the line . . . positive shut-off is assured by "seals" of pressurized lubricant. The result: quarter-turn, positive flow control plus greatly increased valve life at far lower cost.

Rockwell-Nordstrom valves are available in a full range of sizes, metals and pressures for chemical process services. Write for complete details: Rockwell Manufacturing Company, Pittsburgh 8, Pa. Canadian Valve Licensee: Peacock Brothers Limited.

ROCKWELL-Nordstrom VALVES

it's ROCKWELL

MANUFACTURING COMPANY

Rockwell Manufacturing Company
Pittsburgh 8, Pa.

Please send free booklet V-203 ☐

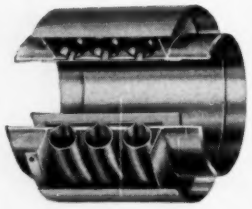
Please have your sales engineer call ☐

Name_____ Title_____

Address_____

City_____ Zone_____ State_____

NEW ZALLEA HyPTor* TOROIDAL EXPANSION JOINT



HyPTor corrugations have a circular or toroidal cross section which provides a lower operating stress at any given pressure than any other corrugation shape.

For unequalled endurance at pressure and temperature extremes

This unique toroidal expansion joint with thin-walled bellows is setting new performance and durability records in high pressure, high temperature service. It was developed to meet the severest operating conditions without sacrificing long life.

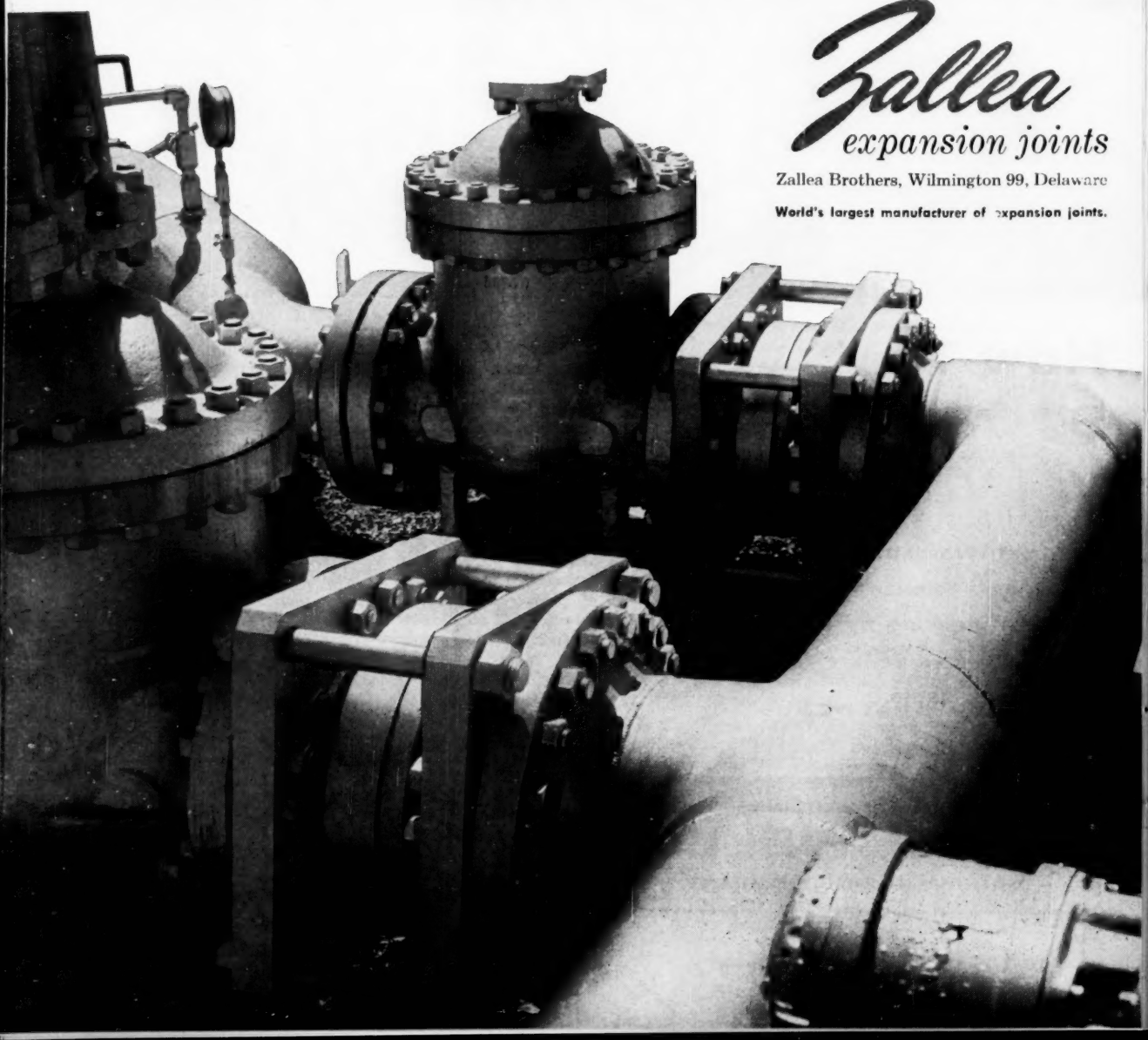
Minimum stress at high pressures is one advantage of the Zallea HyPTor. This is due to the thin-walled bellows and toroidal corrugations. Thin walls develop lowest flexing stress. The toroidal cross section assures lower operating stress at any pressure.

Superior performance at high temperatures. The toroidal corrugation of the HyPTor makes it suitable for use at high temperatures. Also, the HyPTor is hydraulically formed and free from circumferential welds which would act as stress raisers.

Longer life on the job. The ability of the HyPTor to absorb punishment without ill effects has been proved in service. A number of HyPTor Expansion Joints designed for 700 psi working pressure, were installed in liquid oxygen service in 1948. They are still operating . . . at pressures up to 2300 psi.

Get the complete story of the new Zallea HyPTor Expansion Joints. Our new 72-page Expansion Joint Manual gives full details—plus worthwhile information on basic types, design and installation data, expansion joint selection and recommended specifications. Write on your Company letterhead, for your free copy of Catalog 56, Zallea Brothers, 879 Locust Street, Wilmington 99, Delaware.

*Patented

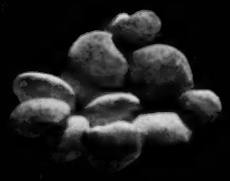


Zallea
expansion joints

Zallea Brothers, Wilmington 99, Delaware

World's largest manufacturer of expansion joints.

You can improve operating efficiencies, cut costs, increase product quality with...



International High Purity

99.0+% MAGNESIUM OXIDE

chemical specifications

chemical		purity range
MAGNESIUM OXIDE	MgO	99.40 – 99.70%
IRON	Fe_2O_3	0.03 – 0.06
LIME	CaO	0.07 – 0.08
ACID INSOL.*		0.02 – 0.10
OXIDES**	R_2O_3	0.04 – 0.09
BORON	B_2O_3	0.0025 – 0.015
CHLORIDE	Cl	0.02 – 0.08
SULFATE	SO_4	0.02 – 0.09
SODIUM AND POTASSIUM	Na+K	0.02 – 0.07
LOSS ON IGNITION		Nil

*Mainly SiO_2

**Other than Fe_2O_3

INTERNATIONAL MgO HAS DEMONSTRATED ITS SUPERIORITIES FOR THESE AND OTHER USES

- *As a high purity raw material for fused refractories.*
- *As a low boron source of magnesia.*
- *As an alkali precipitant for controllable reactions.*
- *In the manufacture of high purity magnesium chemicals.*
- *For blending and upgrading with other magnesias.*
- *For high grade ceramic and glass formulations.*
- *In low sulfate, high magnesia catalysts.*

INTERNATIONAL MINERALS *International* MINERALS CHEMICALS **& CHEMICAL CORPORATION**

POTASH DIVISION .... 20 N. Wacker Drive, Chicago 6

485 LEXINGTON AVE., NEW YORK 17 · MIDLAND, TEXAS · FULTON NATIONAL BANK BLDG., ATLANTA, GA.

physical specifications

(Color . . . White)

PELLETS:	Approx. 1/8" x 3/8", plus 12 mesh Bulk density: 60 lb. cu. ft.
GRANULAR:	90% minus 12 mesh Bulk density: 70 lb. cu. ft.
POWDERED:	100% minus 200 mesh 90% + minus 325 mesh Bulk density: 80 lb. cu. ft.

INTERNATIONAL MINERALS & CHEMICAL CORPORATION
20 North Wacker Drive, Chicago 6

☐ Please send me samples of MgO in ..... form
(pellet – granular – powdered)

☐ Please send Magnesium Oxide Brochure

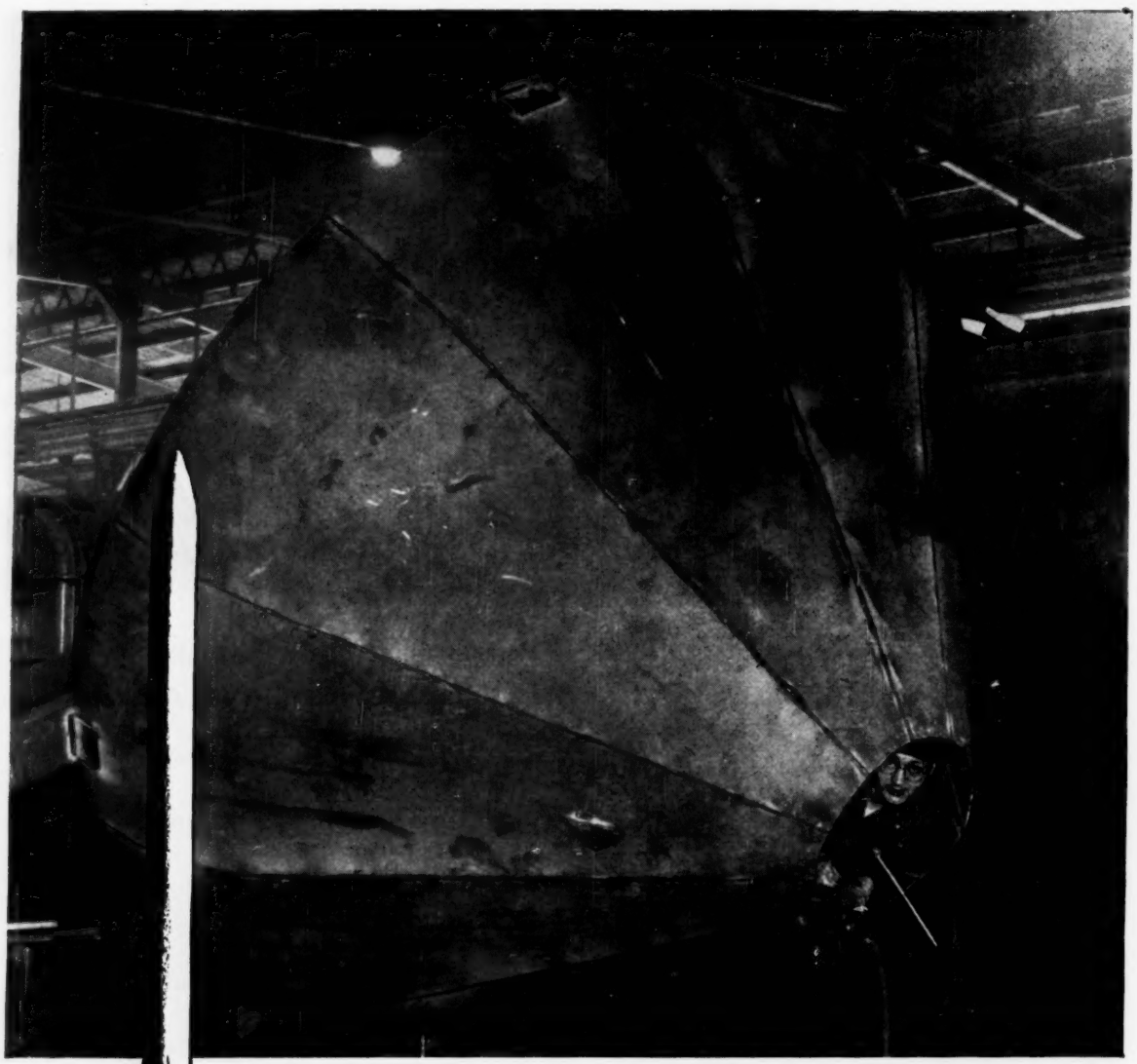
My field of interest for MgO is .....

Name .....

Firm .....

Address .....

City ..... State .....



STAINLESS...for Moon Travel Tests?

The results of this welder's work may well be headed for the moon someday. For here his skills are being applied to a stainless steel component of ground propulsion test equipment as part of the missiles program. There can be no question about test equipment standing up. Hot formed from Type 347 stainless, this unit, one of a number, was welded and X-ray tested with Graver's modern techniques. When exacting design for missile testing is linked with Graver's skilled alloy fabrication, there's assurance of the quality demanded—in the same manner that Graver has served industry for over a century.

GRAVER®
ALLOY DIVISION

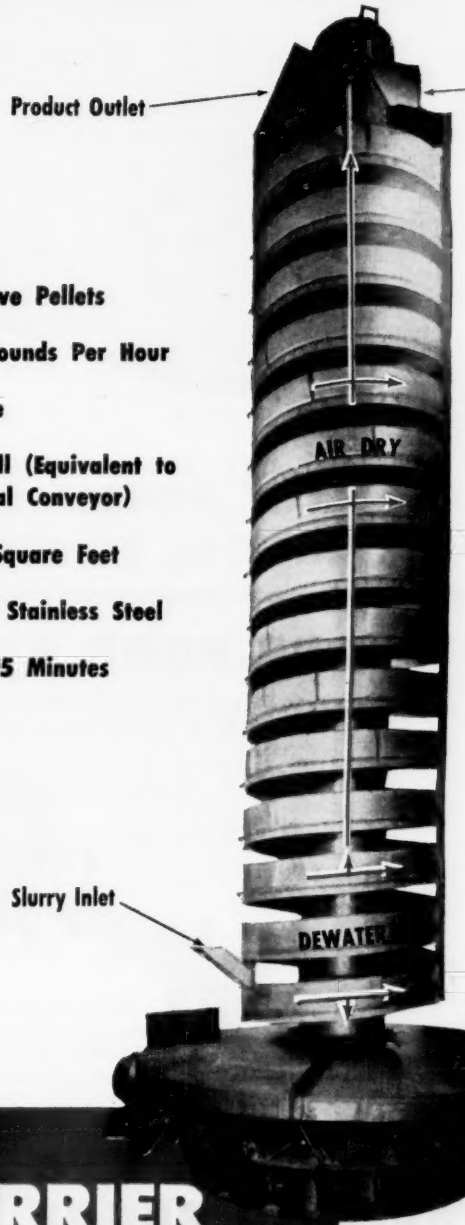
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From Slurry To 0.3% Moisture!

CARRIER SPIRAL ELEVATOR PROCESSES EXPLOSIVE PELLETS

DEWATERS • DRIES • ELEVATES • IN ONE OPERATION



MATERIAL—Explosive Pellets

CAPACITY—2100 Pounds Per Hour

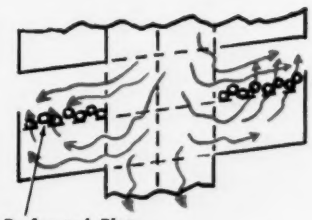
HORSEPOWER—Five

HEIGHT—18′ Overall (Equivalent to 118′ of Horizontal Conveyor)

FLOOR AREA—36 Square Feet

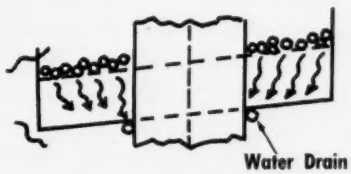
FABRICATION—304 Stainless Steel

RETENTION TIME—15 Minutes



PELLETS AIR-DRIED TO 0.3% MOISTURE

Blower: 8000 CFM
Pressure: 5″ Water
Temperature: 165°F.



SLURRY DEWATERED FROM 10% SOLIDS TO 97% SOLIDS IN TWO TURNS

CARRIER
NATURAL-FREQUENCY PROCESS EQUIPMENT

Carrier Conveyor Corporation
110 North Jackson Street
Louisville 3, Kentucky

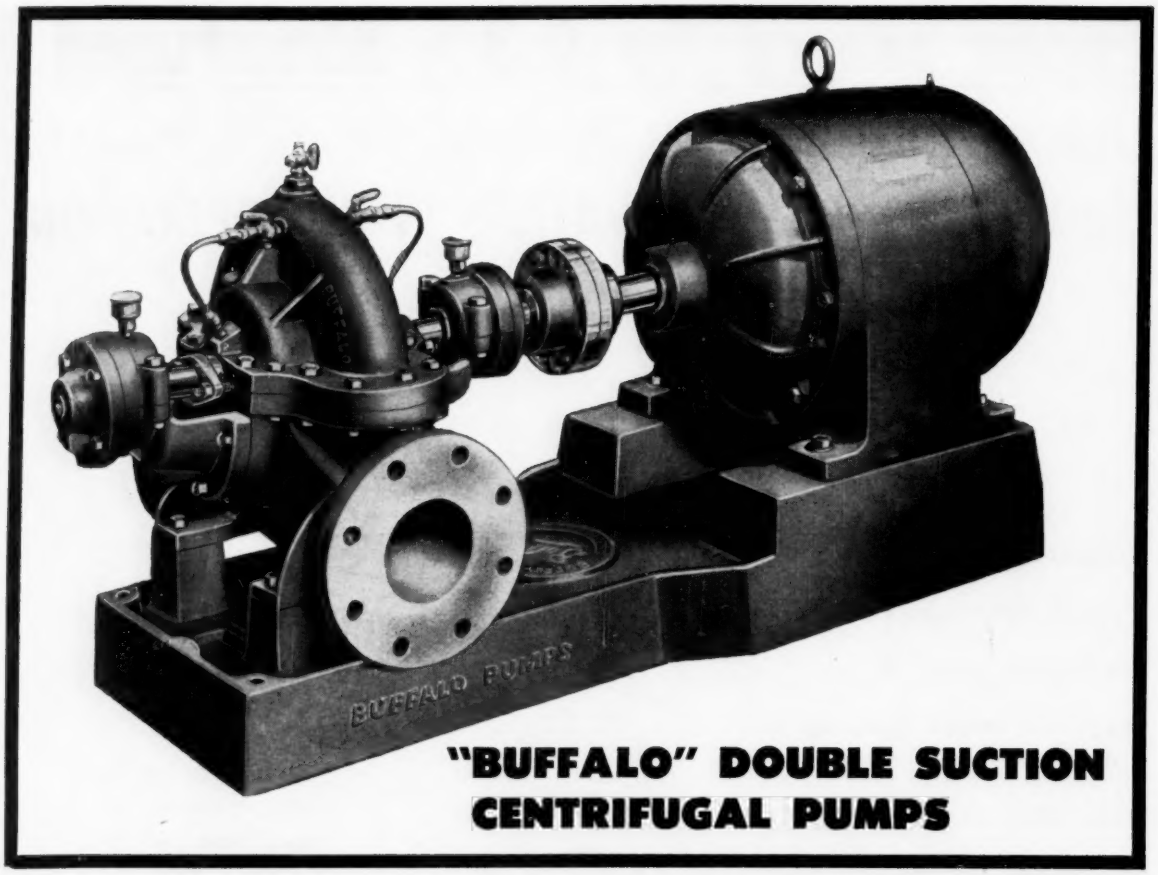
Please rush complete information about Carrier Natural-Frequency Processing Equipment.

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Firm_____

Street_____

City_____ State_____



"BUFFALO" DOUBLE SUCTION CENTRIFUGAL PUMPS

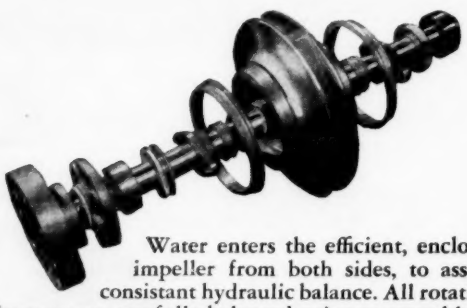
OFFER MORE FOR YOUR PUMP DOLLAR

- Long Life
- High Efficiency
- Quiet Operation
- Reliability
- Minimum Down Time for Repairs
- Availability of Replacement Parts

"Buffalo" Pumps' engineering and rugged, dependable construction make them highly desirable for demanding industrial service. For example, "Buffalo" Double Suction Pumps for dependable clear water service feature precision-machined casings with ample water passages — impellers designed for highest efficiencies — bronze wearing rings — sturdy shafts and heavy-duty ball bearings.

The complete line of "Buffalo" Double Suction Pumps, in capacities from 10 to 14,000 gpm, assures the pump that's tailored to *your* clear water moving needs — *exactly*. For full information, contact your nearby "Buffalo" Engineering Representative, or write for Bulletin 955-R.

Value Beneath the Surface . . . the impeller and shaft assembly of the "Buffalo" Double Suction Pump.



Water enters the efficient, enclosed impeller from both sides, to assure consistant hydraulic balance. All rotating elements are carefully-balanced prior to assembly.

The value "bonus" in every "Buffalo" Pump is the "Q" Factor — the built-in QUALITY which assures trouble-free satisfaction and long life.

"Buffalo" PUMPS

BUFFALO PUMPS

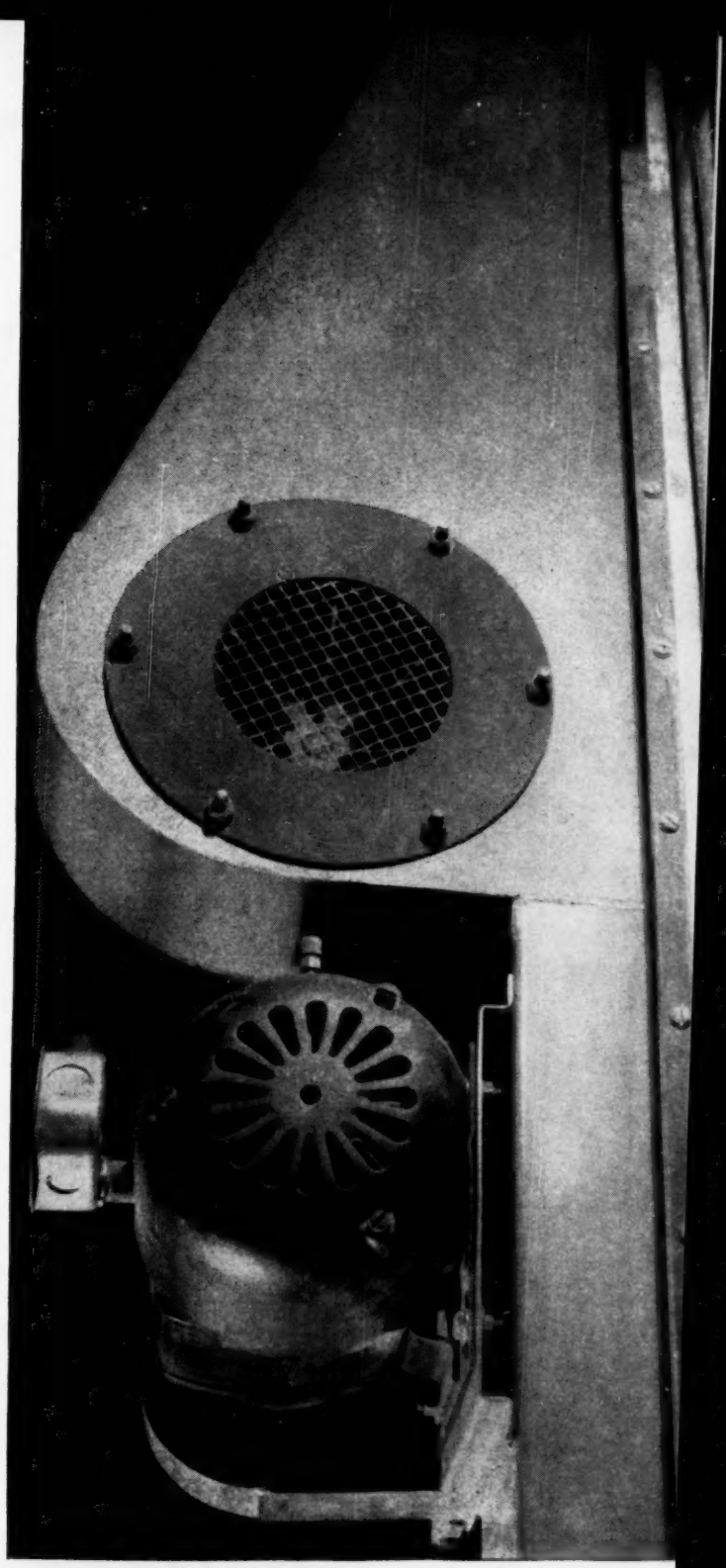
DIVISION OF BUFFALO FORGE CO.

501 Broadway • Buffalo, N. Y.

Canada Pumps, Ltd., Kitchener, Ont.
Sales Representatives in all Principal Cities

A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID

You're looking at the exclusive key to continuous dust collecting!



You are inside a Pangborn Dust Collector. And this is Pangborn's traveling manifold . . . the exclusive self-cleaning development that permits continuous suction at highest efficiency. The result is the incomparable performance of cloth type collectors with minimum resistance to air flow and with no shutdown required.

Typical Pangborn engineering . . .

This advance is particularly important in collecting finely-divided dry dusts. But the Pangborn engineering it typifies is important to *any* dust-producing plant. It is not enough to place a dust collector within a plant. An efficient dust collecting system must be *scientifically* planned, designed and constructed to handle effectively a specific dust problem. This *thinking* is incorporated into every Pangborn proposal.

. . . that can help you

One of Pangborn's comprehensive line of dry and wet dust collectors can be utilized in a Pangborn-engineered dust system to solve *your* dust problem . . . whether it involves any kind of fine, coarse, dry, moist, corrosive, hot or obnoxious dusts.

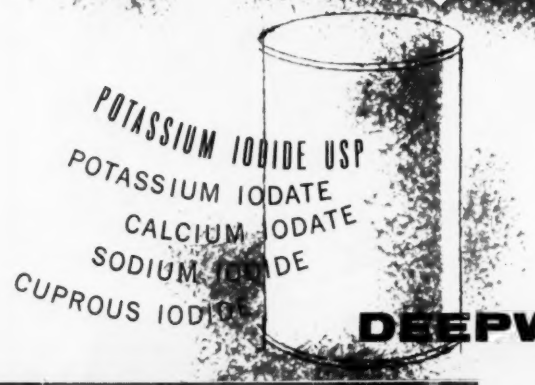


The Pangborn engineer in your area will be glad to take off his jacket and go to work for you. He is a dust *expert* and will discuss your individual problem at no obligation. And, for more information, write for "Out of the Realm of Dust" to: PANGBORN CORP., 2600 Pangborn Blvd., Hagerstown, Md. *Manufacturers of Dust Control and Blast Cleaning Equipment.*

Pangborn CONTROLS DUST

The *Patterson* VACUUM DRYER

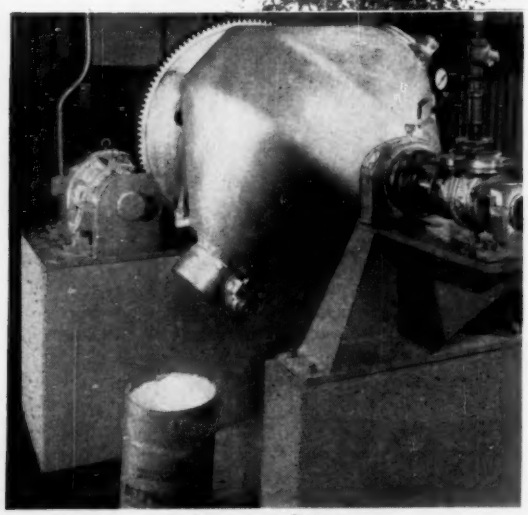
Conaform®



275% FASTER

than tray drying at

DEEPWATER CHEMICAL



Here's how *Conaform* changed the drying cycle for Deepwater Chemical Co., Ltd. from 16 hours to 6!

In place of bulky tray dryers, occupying a large amount of floor space, Deepwater Chemical installed a single, compact Patterson Conaform Vacuum Dryer in their Compton, California plant. This efficient unit dries potassium iodide (centrifuged to a surface moisture of 2%) down to .02% in 6 hours—*compared to 16 hours required for tray drying.*

In addition, the Conaform Dryer provides gentle action without damage to delicate crystal structures, and prevents caking or contamination of product.

Other Deepwater chemicals Conaform-dried with equal effectiveness include potassium iodate, calcium iodate, sodium iodide, and cuprous iodide with higher surface moisture. Let us discuss the application of Conaform's drying speed to your own production betterment!

ADVANCED PROCESS EQUIPMENT *OF ENDURING SATISFACTION*

THE *Patterson* FOUNDRY AND MACHINE COMPANY

A Subsidiary of Ferro Corporation

East Liverpool, Ohio

THE *Patterson* FOUNDRY AND MACHINE COMPANY (CANADA) LIMITED

Toronto, Ontario

new chemical plant

DESIGNED AND BUILT IN JUST SIX MONTHS

Undivided responsibility for engineering, procurement and construction services enabled CATALYTIC to build a new, operating chemical plant in just six months!

This unique performance called for precise coordination between the client and the contractor—to CATALYTIC, this project was a welcome opportunity to meet the challenge of on-time, on-budget performance . . . to show SKILL, EXPERIENCE and IMAGINATION at work.



CATALYTIC
CONSTRUCTION COMPANY

Philadelphia 2, Pennsylvania
Baton Rouge, Louisiana
Toledo, Ohio • Tulsa, Oklahoma

In Canada: Catalytic Construction of Canada, Limited; Sarnia, Ontario; Toronto, Ontario; Montreal, Quebec

Catalytic *On-Time...On-Budget* Services for the metallurgical, chemical, petrochemical and oil refining industries: Project Analysis; Process Development; Process Design; Economic Studies; Engineering; Procurement; Construction.



This Tube is Precision Bored to Rifle Barrel Accuracy



Ashcroft Duragauge in Phenol case – a tough, rigid plastic turret type case for wall or flush mounting.

The Bourdon tube in Ashcroft Duragauges is machined mirror-smooth inside and finish ground outside to exact tolerances. Strong, uniformly thick walls assure precise flexibility–sustained high accuracy and long life.

Eight tube materials permit you to select the best metal with sensitivity balanced by internal corrosion resistance. Whether your choice is phosphor bronze, an alloy steel, "K" Monel, a stainless steel or beryllium copper, metallurgical control is exact from ingot to finished tube. Socket and tip joints are welded or brazed, then stress relieved for highest strength and safety. "Whip testing" at pulsating pressures at least 50% greater than rated pressure insures calibration stability.

Order your Ashcroft Duragauges with the best Bourdon tube material for your service. Choose the all-stainless-steel movement or stainless steel with nylon bearings and pinion gear. Full range of pressures, dial sizes, case designs and materials available. In any combination of components, Duragauges give sustained high accuracy and long service. Get details from your industrial supply distributor.

MAXWELL MANNING M&M & MOORE, INC. TRADE MARK

ASHCROFT PRESSURE GAUGES

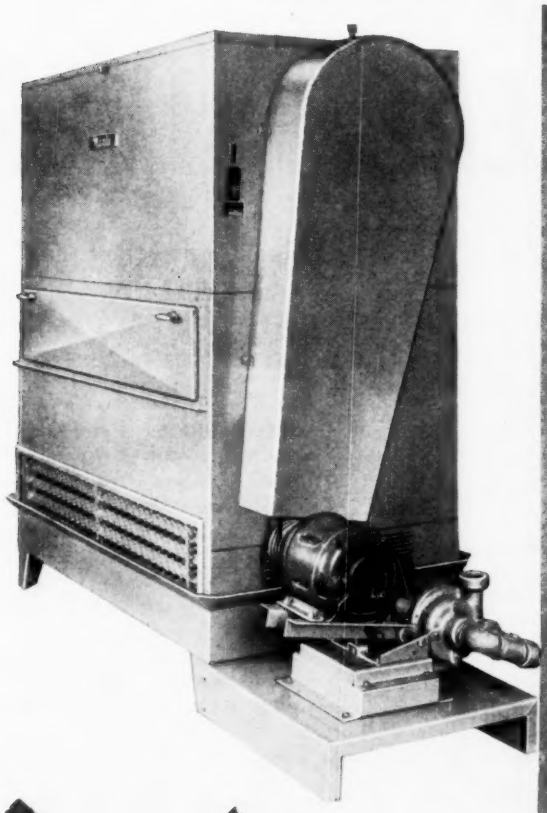
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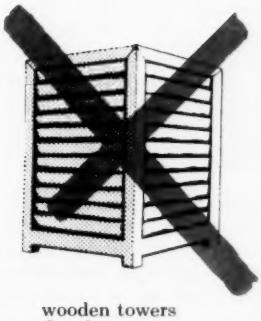
MANNING, MAXWELL & MOORE, INC.

Consolidated Ashcroft Hancock Division • Stratford, Connecticut

In Canada: Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario

for COMPACTNESS... LONG LIFE... and LOW COST MAINTENANCE!





wooden towers
Cumbersome,
Hazardous



Marlo
all metal towers
Compact, Safe

MARLO

coil co.

SAINT LOUIS 11, MISSOURI

Quality Air Conditioning and Heat Transfer Equipment since 1925

Marlo

all metal cooling towers in durable stainless steel construction

- completely fireproof
- resists rot and corrosion
- easy to maintain
- compact, space saving
- quiet operating
- indoor or outdoor installation
- controls for winter operation

FOR MORE INFORMATION, SEND COUPON ATTACHED TO YOUR LETTERHEAD

MARLO COIL COMPANY
7100 S. Grand Blvd.,
St. Louis 11, Mo.

Please send me information on the following Marlo equipment.

- ☐ HEATING AND COOLING COILS
- ☐ COOLING TOWERS
- ☐ EVAPORATIVE CONDENSERS
- ☐ COIL TYPE SPRAY DEHUMIDIFIERS

Name_____

Company_____

Address_____

City_____ Zone____ State_____

Alloy Steel Products Company

sets up new Division to specialize in

NUCLEAR VALVES

Complete separate facilities provide prime source of supply for expanding nuclear industry

With over 29 years of specialized experience as a leading producer of high alloy valves for the process and related industries, it was natural for Alloy Steel Products Co. to be called upon to help with the valve problems of the new and progressive nuclear industry. Alloy Steel Products Co. has contributed to the development and production of various types of valves for critical applications in nuclear reactor plants.

With the need for nuclear valves increasing so rapidly, Alloy Steel Products Co. recognized that the only right way to serve the nuclear industry was to set up a complete and separate Nuclear Division with extensive facilities for design, engineering, manufacturing, testing, and sale of the special types of valves required. Today, with a completely new plant, an engineering staff selected for technical background and experience in the nuclear field, and some of its nuclear valves actually in production, the Nuclear Division is an accomplished fact.

The new facilities are equipped with the finest, most modern machinery. A hot test loop with circulating demineralized water which duplicates production pressures and temperatures up to 2500 psi and 650° F will be available for engineering and production tests. Facilities are provided for cleaning valves and castings to nuclear cleanliness standards.

The Aloyco Nuclear Division is designed to produce low pressure valves up to the 24-inch size, and high pressure valves up to the 18-inch size. Aloyco Nuclear valves are designed for practically any type of radioactive piping system. These include power and research reactor coolant systems, fuel processing systems, and waste disposal systems. The Nuclear Division will apply its know how and its nuclear facilities to improve the state of the art while supplying the industry's valve needs.

NOW IN PRODUCTION... Already certain nuclear valve lines are well beyond the design stage. Two complete lines of bellows sealed valves designed for highly radioactive, toxic, or explosive fluids are now in production. The Nuclear Division is prepared to quote on:

- Main coolant system check valves
- hydraulically or electrically operated main coolant system stop valves
- bellows sealed valves for highly radioactive, toxic or explosive fluids
- low pressure valves for demineralized high purity water service
- high pressure "capped" valves for throttling, isolation, drain, and instrument lines
- manually operated gate and globe valves for a myriad of auxiliary high pressure and temperature services

The Nuclear Division of Alloy Steel Products Co. invites your inquiries on the above listed and other valves for nuclear application. The engineering services of the division are available to you for consultation on your nuclear valve problems. Write us at 1301 West Elizabeth Ave., Linden, N. J. 8.4

FACTS ABOUT ALLOY STEEL PRODUCTS CO.

Although the reputation of Aloyco Valves is well known in the process industries, here are a few words about the Company for nuclear engineers.

Two facts make Alloy Steel Products' entry into the nuclear valve field a logical forward step. First, we have specialized for 29 years in one thing only—the design and manufacture of stainless steel and high alloy valves. We are the only company that does so. We built our own integrated foundry to produce a single product—pressure tight, mechanically sound stainless steel valve castings.

The same principle of putting quality first is evident in our design, engineering, machinery, control procedures and even our sales approach. Aloyco Sales Engineers handle one line only, know their business, and are equipped to be of real service to our customers.

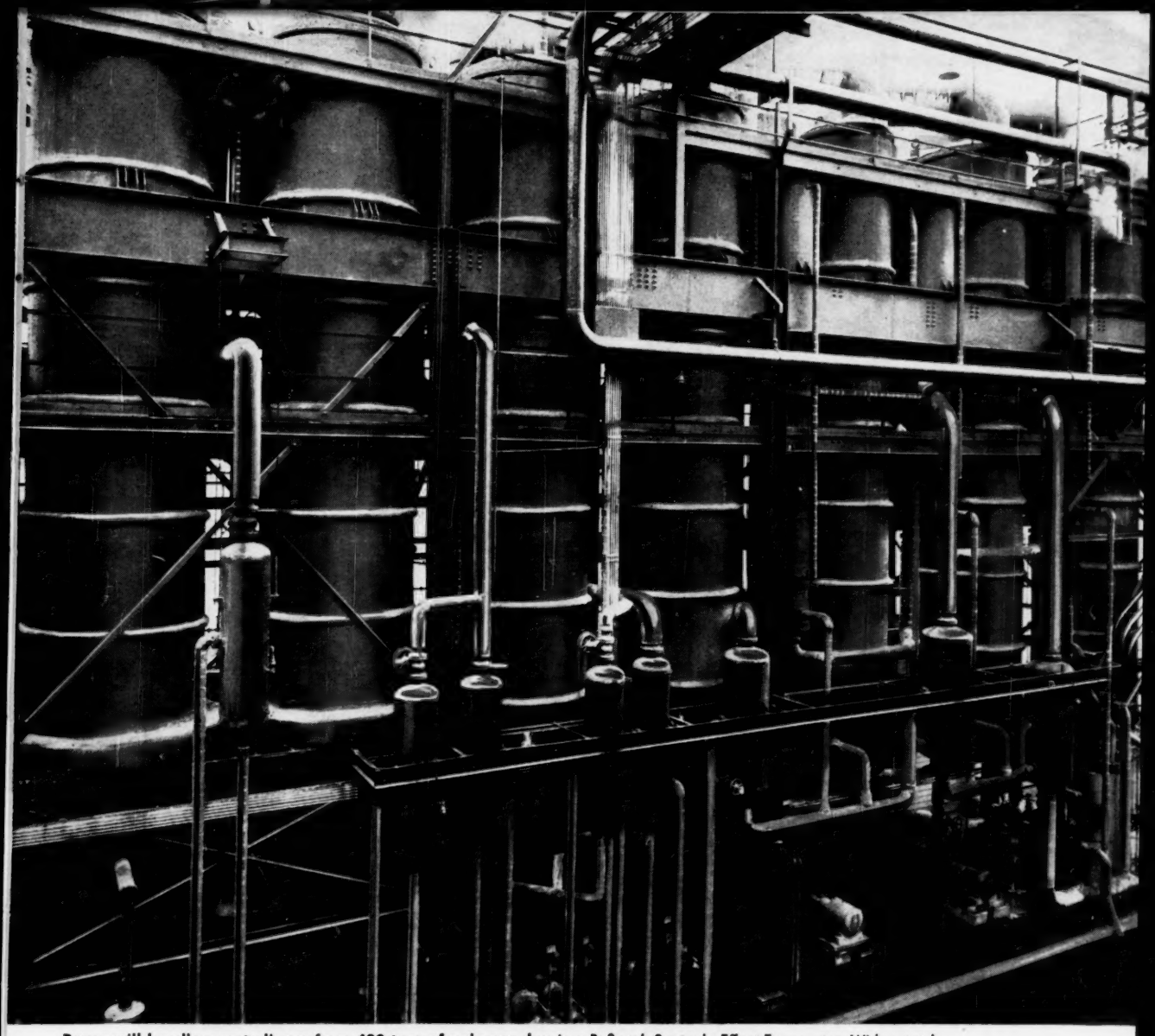
This is a company that was built and has gone forward on the quality of its products. This is the second fact that makes our entry into the nuclear field, with its exacting requirements, so logical and inevitable. You can depend on the extremely high quality of Aloyco nuclear valves.

ALLOY STEEL PRODUCTS COMPANY

NUCLEAR DIVISION

Linden, New Jersey





Paper mill handles waste liquor from 400 tons of pulp per day in a Buflovak Septuple Effect Evaporator. With a total heating surface of 66,500 square feet, this especially designed unit evaporates 6.3 pounds of water per pound of steam.

Longview Fibre Company cuts steam needs with unique Buflovak Evaporator

Saved: 2,500 pounds of steam per hour in concentrating waste black liquor. In designing and building this giant, septuple effect evaporator, Buflovak engineers used three vapor heat exchangers to lower steam requirements . . . boost operating efficiency.

Waste solids produced by the Buflovak evaporator can be eliminated profitably. Instead of creating a difficult disposal problem these wastes are burned as an auxiliary boiler fuel.

Processing economies like these are typical of Buflovak job-engineered evaporators. Because Buflovak builds a full evaporator line, you are sure of an impartial recommendation based exclusively on your needs.

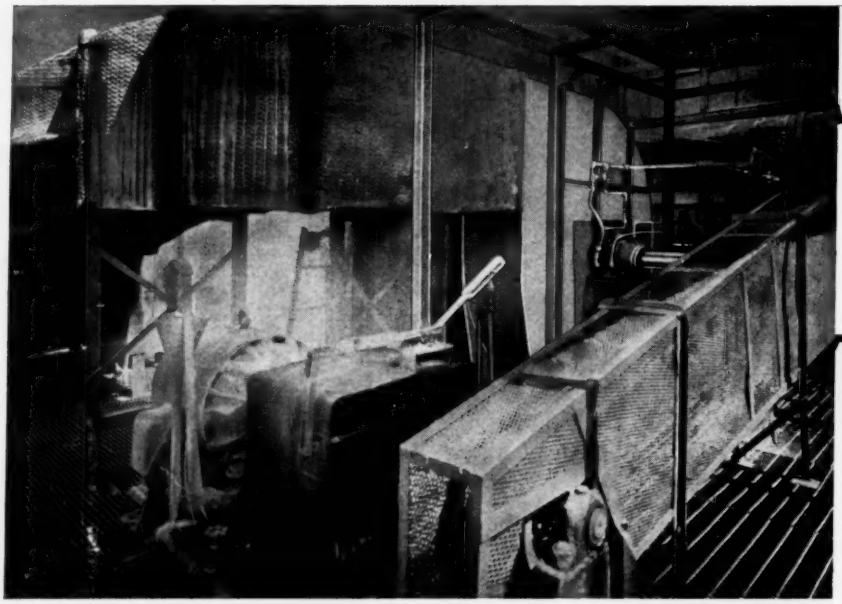
Pre-test your evaporating process in Buflovak's Customer Service Laboratory

This fully equipped research center contains both small scale and pilot size testing equipment. Whether you examine a beaker of material or make a full scale production run, you'll get dependable results, accurate data . . .

Write for Catalog 372 on evaporators. Catalog 381 on the lab. Also refer to C. E. Catalog, pages 429 to 452.

BLAW-KNOX

BLAW-KNOX COMPANY
Buflovak Equipment Division
1551 Fillmore Avenue, Buffalo 11, New York



One of several Clarage Type XL Fans used in this application. Fan equipped with stainless steel wheel and V-belt driven from a hydraulic coupling.

Clarage Fans have what it takes

for this tough exhaust assignment in the production of titanium dioxide

Exhausting 800° F gases from rotary calciners through scrubber units and electrical precipitators to the atmosphere.

That's the demanding task this large chemical manufacturer gave Clarage Type XL Fans.

What kind of a job evaluation does Clarage receive? Several repeat orders furnish the answer. In fact, three additional Clarage Fans will soon be installed in a major expansion at this plant.

You, too, will find it pays dividends to choose the fan name of quality — Clarage. Call us in for capable assistance on your next requirements in the air handling and conditioning field. It's characteristic of Clarage equipment to prove out successfully no matter how exacting the application. CLARAGE FAN COMPANY, Kalamazoo, Michigan.

CLARAGE ... *dependable equipment for making air your servant*

SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • IN CANADA: Canada Fans, Ltd., 4285 Richelieu St., Montreal



Photograph courtesy of Standard Oil Company (N. J.)

When are 16 pipe stills as good as 20?

When a Ljungstrom® Air Preheater gives each one 25% greater capacity

You can get 25% greater production from a pipe still when you install a Ljungstrom® Air Preheater. An Air Preheater can raise combustion air temperature as much as 1,000 F by recovering waste heat from the still exhaust. The increase in combustion air temperature permits an important increase in the output of your still per barrel of fuel consumed.

For example, at one East Coast refinery the installation of a Ljungstrom increased the capacity of a pipe still from 16,000 to 18/20,000 barrels. At this same refinery, the installation of a Ljungstrom, together with modern fuel-burning equipment, gave finer product control which boosted product ratings an average of 2 octane numbers for an added annual income of $58,000.

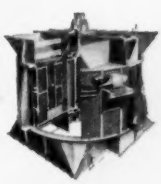
How fast is "WRITE OFF"?

Users report that increased capacity and improved product quality *alone* pay the cost of the Ljungstrom in as little as nine months. You use 20% less of your regular fuel per barrel of output, or you can switch to cheaper fuels that were previously considered useless. Maintenance is less, too, because a Ljungstrom makes the fuel burn more completely, with minimum slag deposits.

For more complete details on what the Ljungstrom Air Preheater can do for you—for an analysis of the heat recovery benefits attainable in fuel-burning equipment—call or write The Air Preheater Corporation.

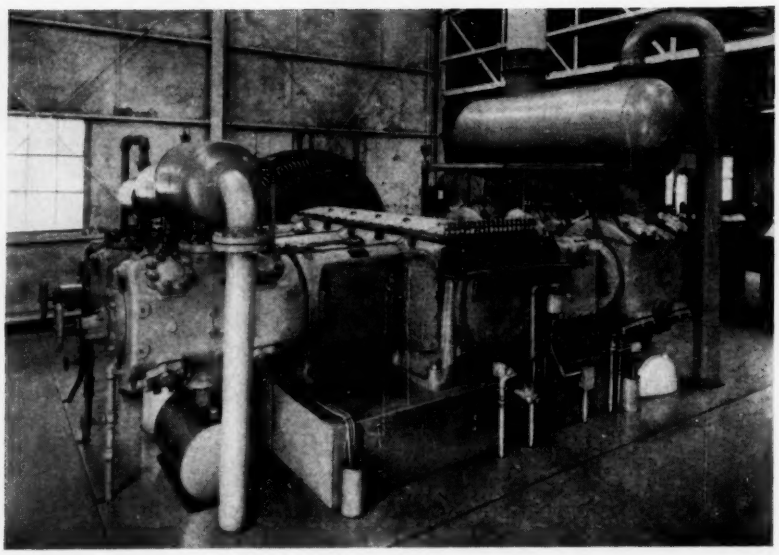
Wherever You Burn Fuel, You Need Ljungstrom

The Ljungstrom operates on the continuous regenerative counterflow principle. The heat transfer surfaces in the rotor act as heat accumulators. As the rotor revolves, the heat is transferred from the waste gases to the incoming cold air.



The Air Preheater Corporation 60 East 42nd Street, New York 17, N. Y.

Located in the Oakland, *California plant of the Pacific Oxygen Company, this 5-stage Cooper-Bessemer FM, rated 800 hp at 300 rpm, handles the compression of air from atmosphere to 2250 psig.*



at Pacific Oxygen...

17,000 hour check proves continuous availability of **Cooper-Bessemer** *compressor*

Operating as a 24-hour a day unit, this motor-driven Cooper-Bessemer FM compressor provides the dependability so necessary in the efficient production of liquid oxygen.

Recently, after 17,000 operational hours, an inspection of this 6-cylinder compressor revealed all parts in exceptionally good condition . . . proof of how Cooper-Bessemer delivers the type of performance that assures availability and eliminates costly "downtime".

For every air requirement in the 200 to 10,000 horsepower range, you will profit by remembering that Cooper-Bessemer answers the demand for heavy-duty, continuous operation at low cost. You can quickly obtain complete information by contacting the Cooper-Bessemer office nearest you.

Write for your free copy of the new 44-page Industrial Air Bulletin M-81. Address The Cooper-Bessemer Corporation, Mount Vernon, Ohio



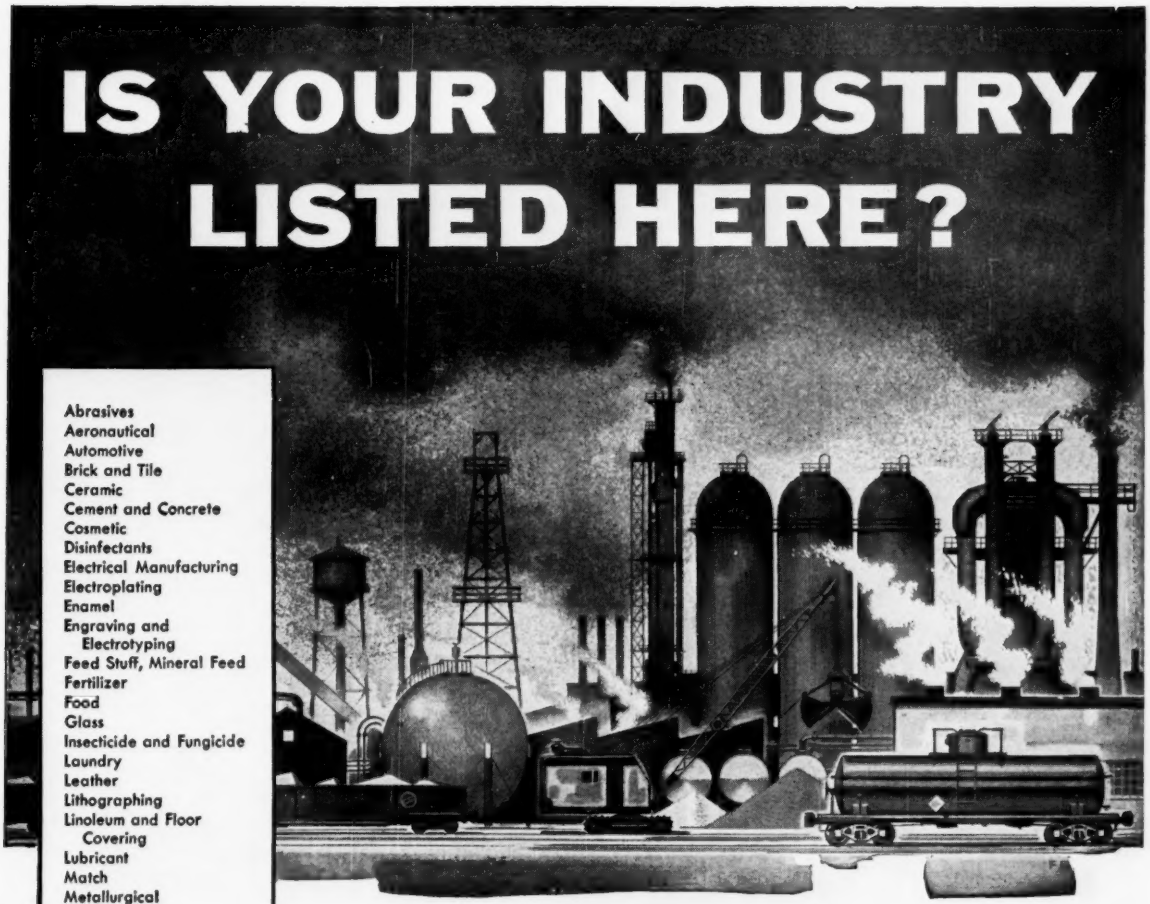
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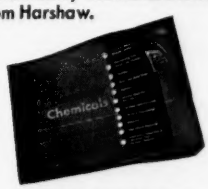
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THE HARSHAW CHEMICAL CO.

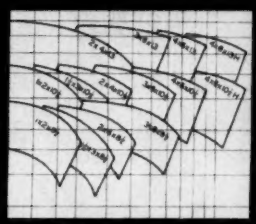
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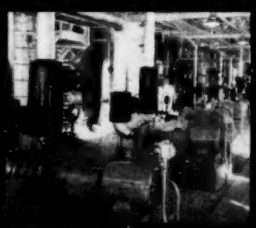
Now—

ENGINEERS *are saying this about Peerless Process Pumps—*

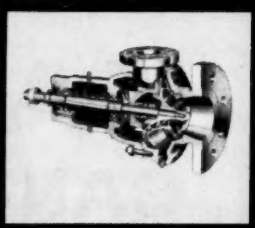
WE CAN BE SURE!



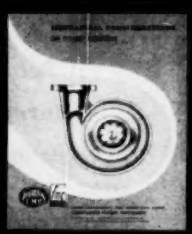
PEERLESS PROCESS PUMPS offer *pinpoint* selection. Thousands of combinations from the complete Peerless line assure you of characteristics that *fit exactly* your system's every requirement.



PEERLESS PROCESS PUMPS meet *today's* pumping needs, and *tomorrow's* as well. Peerless process pumps are built to *expand* with your future system and *still offer a custom* performance pump at an *off-the-shelf* price!



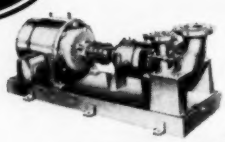
PEERLESS PROCESS PUMPS provide *field-proved performance*, verified by thousands of case histories of pumps in all duties. With Peerless, you get a pump that *you know* will do *exactly* what you buy it for.



RESEARCH AT PEERLESS is exemplified by this bulletin, "MECHANICAL CONSIDERATIONS IN PUMP DESIGN," dealing with the effects of radial loads on process pumps. Request Bulletin No. EM-79.

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Putting Ideas to Work

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Assure Highest Product Quality in Your

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IF your job is to increase efficiency, reduce costs and produce higher product quality in a liquid phase adsorption process, then you'll want to know *more* about the unique benefits of using PITTSBURGH Granular Activated Carbons in a fixed bed column system. Just look at these specific advantages over "batch-type" operations with powdered activated carbons:

1. Greater capacity, lower carbon dosage, lower cost. In effect, you achieve the efficiency of an infinite series of batch-type treatments.
2. Higher product quality, better colors, higher purity.
3. Cleaner operation, no slurrying or dusting problems.
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What's *your* liquid phase adsorption problem? Decolorizing a solution? Refining a food product? Purifying a pharmaceutical? *Pittsburgh coal-derived Activated Carbons, used in a column system, will do a better job at lower cost.* And we have the facts to prove it!

You'll find there's a type of PITTSBURGH Granular Carbon ideally suited to solve your particular adsorption problem. *Write today for your free copy of information brochure on adsorption with activated carbons.*

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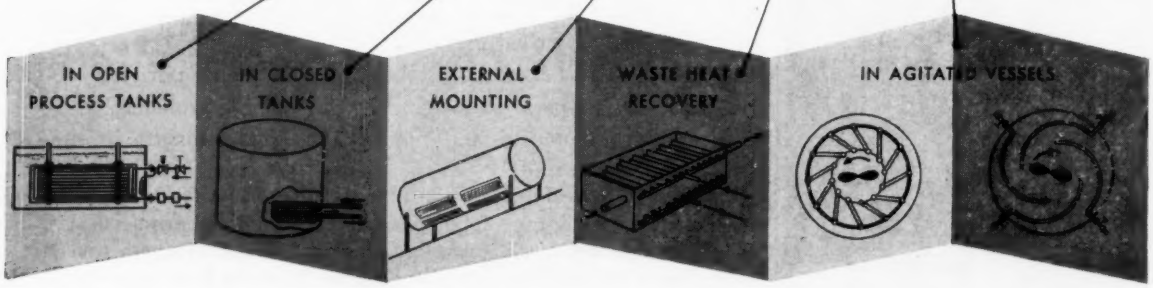
FORMULA FOR SPECIAL HEAT TRANSFER PROBLEMS

your imagination
plus
PLATECOIL®



The simplicity and versatility of Tranter PLATECOIL heat transfer equipment may be just what you've needed for your special heat transfer problems.

A Tranter PLATECOIL consists of two embossed metal sheets, seam and spotwelded together to form channels for the passage of heating or cooling media. Compact, lightweight PLATECOIL units are furnished in a wide range of standard sizes and styles.

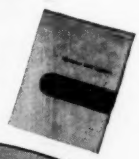


PLATECOIL requires about half the space required by pipe coils and accomplishes heat transfer fully 50% faster than pipe coils.

PLATECOIL units are available in Cold Rolled Steel, Stainless Steel, Carpenter 20, Monel and other corrosion-resistant alloys.

In addition to the many standard styles and sizes, PLATECOIL units can be tailored to fit your exact specifications. Factory fabricated groups, units rolled to specific diameter and units flat on one side are available. PLATECOIL can be galvanized, metallized, electro-polished, polished for food service, prepared for various finishes and furnished with special connections.

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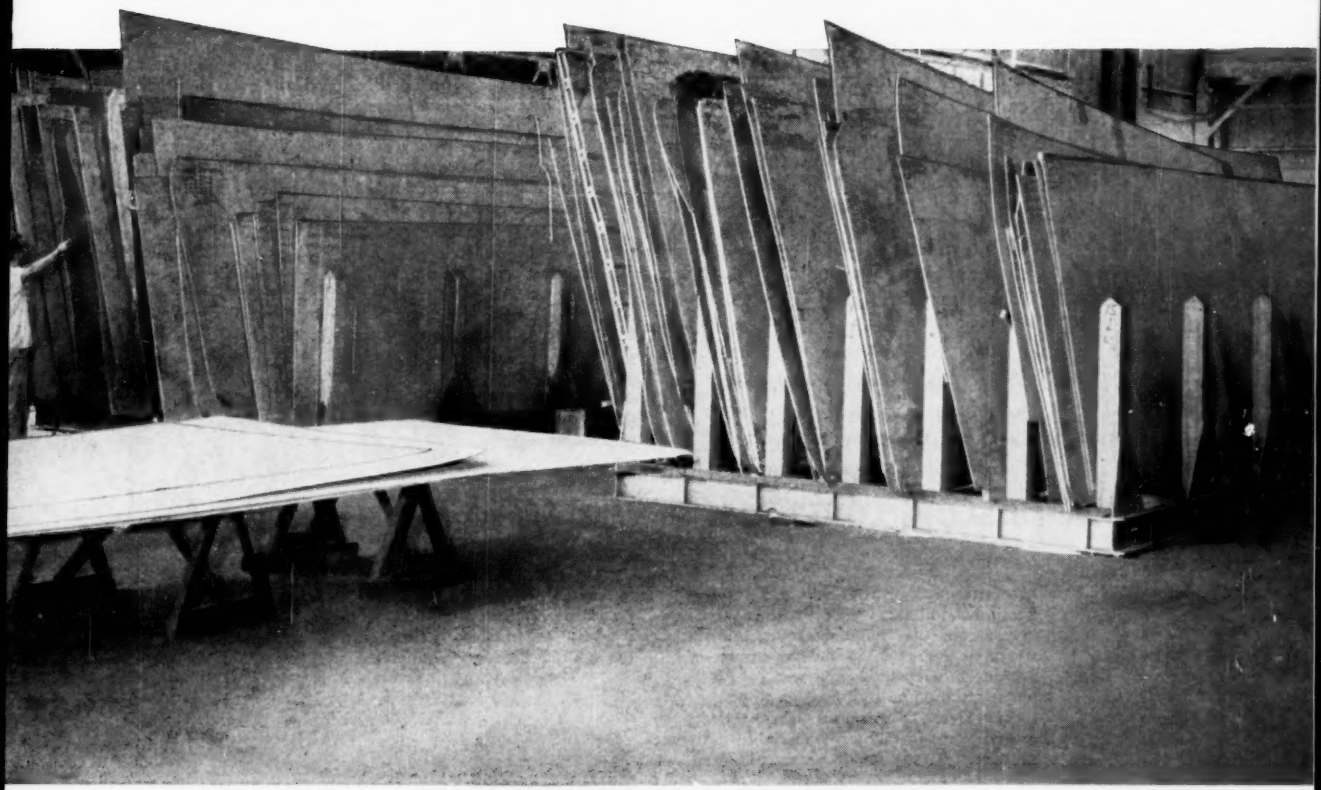
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PLATECOIL® DIVISION



Available now from Carlson

. . . any size and shape you want in Types 405, 410 and 430 stainless plate



Carlson's stock of Types 405, 410 and 430 chromium stainless plate is the largest ever. You can order plates, large or small, and get delivery in a few days. Types 405 and 410 find wide application in petroleum processing. Type 430 is generally used for furnace parts, annealing boxes and nitric acid storage tanks. Consider the 400 series if you need stainless plates right now.

Prompt delivery isn't your only advantage. These grades cost less than chromium-nickel stainless steels and if you need irregular shapes and sizes, experienced men with specially designed equipment can cut your plates and get them out in a hurry. Carlson provides a complete service with a flexible operation to take care of your specific requirements. This combination of stock, specialization and service saves you time and money, *gives you what you want when you want it!*

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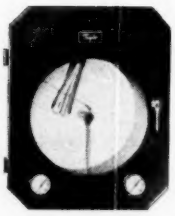
20 *Years the Standard of Control—*
TAYLOR FULSCOPE® CONTROLLERS

1 ***DEPENDABILITY*** Many FULSCOPE Controllers have been in continuous operation for twenty years or more, with practically no major service required.

2 ***ADAPTABILITY*** The basic control mechanism can be changed from the simplest to the most complete form, and to the measurement of any variable—in either recording or indicating models.

3 ***LOW MAINTENANCE*** In addition to being rugged and dependable, the FULSCOPE Controller is unusually easy to understand and simple to service.

4 ***ECONOMY*** The few extra dollars for FULSCOPE quality are paid off by many extra years of trouble-free performance.



FULSCOPE RECORDING CONTROLLER is a versatile instrument for accurate recording and automatic control of one or two variables. It is completely adaptable to practically any control problem through the interchangeability of response forms: **Adjustable Sensitivity** for throttling control on applications with a wide range of time lags and capacities; **Automatic Reset** for precision control on applications involving a wide range of time lags and capacities, with gradual, sustained load changes; **Pre-Act*** derivative response for applications with a wide range of time lags and capacities, with sudden, momentary disturbances, but without sustained load changes. **Any combination of these responses may be had in single or double duty form.**

THE PNEUMATIC SET CONTROLLER is a single duty FULSCOPE Recording Controller in which the set pointer is automatically adjusted by a pneumatic signal from any external source. This reduces the effects of process lag and results in better control—e.g., flow is frequently controlled in direct ratio to another flow or liquid level.

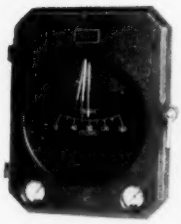
THE RATIO CONTROLLER controls one variable—temperature, pressure, flow, or liquid level—in direct or inverse ratio to some other related variable, and records the adjusting variable. Wide range of ratio adjustments can be made directly on the calibrated dial.

Pick the FULSCOPE CONTROLLER that fits your process requirements . . .



INDICATING CONTROLLER is the simplest form of the FULSCOPE Controller. Wherever a record is not important, this instrument will give satisfactory service as a moderately priced indicating controller for temperature, pressure, flow, or liquid level. It maintains these effects at a constant level, by increasing or decreasing the service that controls them.

An exclusive feature of the FULSCOPE Indicating Controllers is the availability of 2 complete control systems encased in the standard recorder-size case.
(See instrument at right.)





RECORDING CONTROLLER WITH PROCESS TIMER is essentially the same instrument as the FULSCOPE Recording Controller, except that it begins timing the process when the controlled variable reaches the proper point, and turns the process off after a predetermined length of time.



THE TIME SCHEDULE CONTROLLER is a FULSCOPE Recording Controller which will exactly repeat a predetermined program involving time with temperature, pressure, flow, or liquid level. One or two large, chart-size cams are cut to determine the optimum value of the controlled variables at each point in the process time. The instrument set pointer is varied continuously by the progress of the cam follower over the cam contour. A variation of this instrument is the FULFLEX* Time Schedule Controller which has all control adjustments on the front of the case, permitting changes during the process, as commonly required in textile dyeing processes.

Ask your Taylor Field Engineer for further information, or write Taylor Instrument Companies, Rochester, N. Y., or Toronto, Ontario.

*Trade-Mark

Taylor Instruments MEAN ACCURACY FIRST



BUTADIENE CAPACITY INCREASED
365,000 Tons/yr in 1957
85% THRU ISOFLOW HEATERS

...and "Isoflows" in five new Butadiene plants are additionally supplying 1,000,000 lbs/hr of superheated steam up to 1400° F

Butadiene capacity is mushrooming to meet the rising demands of synthetic rubber and chemicals. Of the new butadiene plants put into operation during 1957, Petrochem Isoflow Furnaces have been installed in the 5 largest, representing approximately 85% of the total increased capacity in the U.S.

Isoflow Furnaces efficiently perform two important heating functions, depending upon the butadiene process involved:
(A) To heat directly the butane-butene feed stock and steam to a high temperature for dehydrogenation.
(B) To supply highly superheated steam which in turn heats the butane-butene stock for dehydrogenation.

The unique design and operating features which have led to the wide acceptance of Petrochem Isoflow Furnaces include:

- **Uniform Heat Distribution**
- **Maximum Fuel Efficiency**
- **Low Pressure Drop**
- **Low Maintenance**
- **Zero Air Leakage**
- **Minimum Ground Space**
- **Simplicity of Design and Construction**
- **Short Length of Liquid Travel**
- **Series, Multipass, all parallel flow**
- **Excess Draft for High Overload**

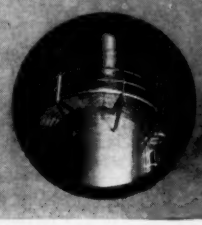
For butadiene production, catalytic reforming or any other petroleum, petrochemical or chemical process there's a Petrochem Isoflow Furnace for any duty, temperature and efficiency.

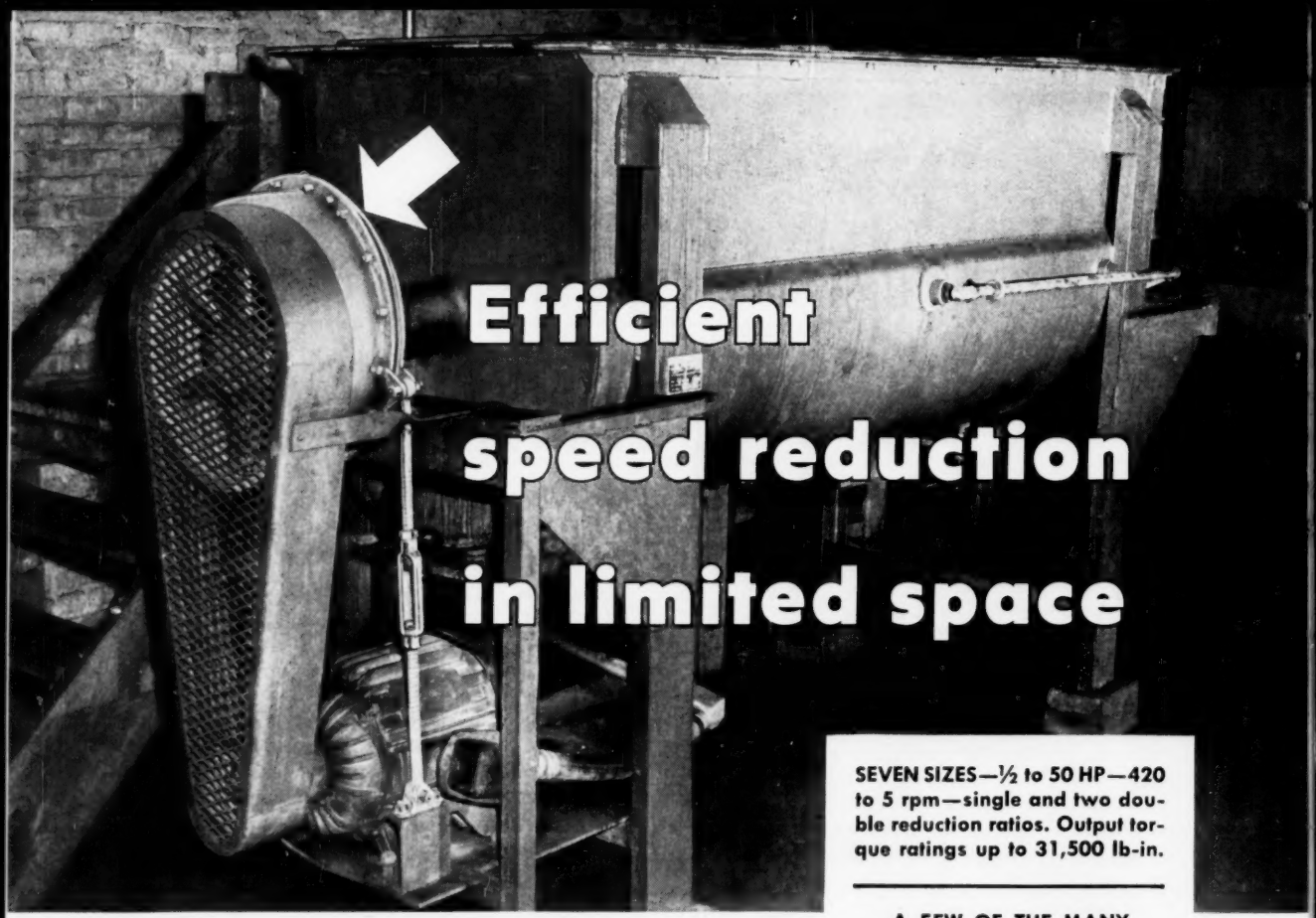
PETROCHEM-ISOFLOW FURNACES

UNLIMITED IN SIZE ... CAPACITY ... DUTY

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SEVEN SIZES—½ to 50 HP—420 to 5 rpm—single and two double reduction ratios. Output torque ratings up to 31,500 lb-in.

FALK ALL-STEEL Shaft Mounted Drives

Wherever you require a highly efficient, economical speed reducing unit to fit into a limited space, the FALK All-Steel Shaft Mounted Drive meets your needs perfectly. This rugged, compact reducer mounts directly on the driven shaft and is driven through V-belt or chain drive from any convenient rotating power source.

It's hard to match the versatility of a Falk Shaft Mounted Drive. You can choose a single or double reduction unit and use it with any of the many possible sheave or sprocket ratios to obtain almost any specified speed between 420 and 5 rpm. Equally important, the standard Falk Shaft Mounted Drive is available for horizontal and vertical application. Delivery is immediate, installation is quick and easy.

These units are completely FALK-designed and FALK-built for a long life of dependable, trouble-free service. *Precision-cut helical gears of highest efficiency* are employed for efficient, quiet operation.

Always available promptly from factory and distributor stocks, from *coast to coast*. For details, ask your Falk Representative or Distributor—or write for **Bulletin 7100.**

A FEW OF THE MANY APPLICATION FEATURES





VARIABLE SPEEDS through use of variable-pitch sheaves—automatic belt adjustment with tie-rod adjustment



OVERLOAD RELEASE that will slacken belts and cut off power if overload occurs

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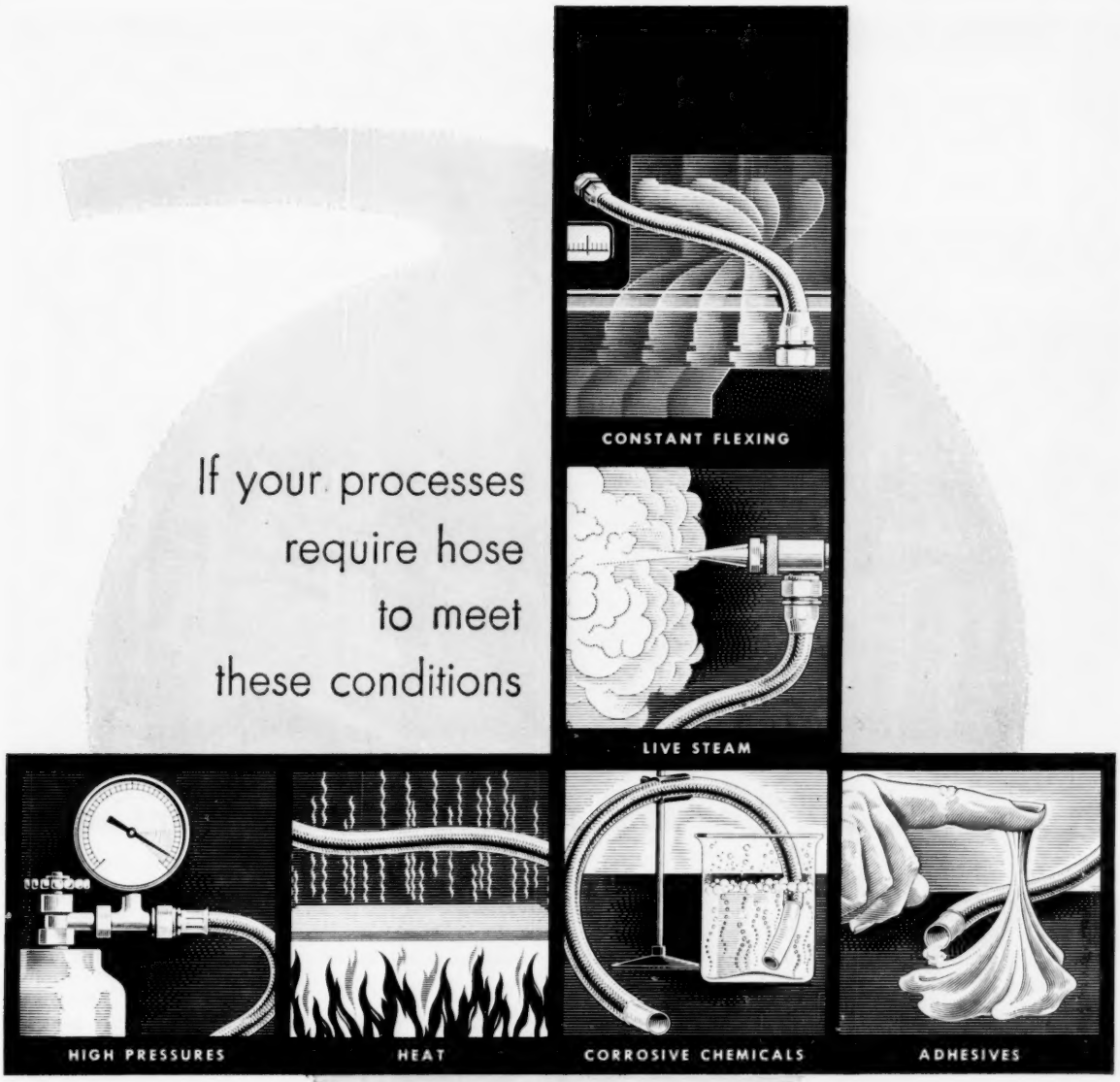
Manufacturers of

- Motoreducers
- Speed Reducers
- Flexible Couplings
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FALK

...a good name in industry

If your processes require hose to meet these conditions



You can save replacement costs, cut maintenance, end leakage losses with hose of TEFLON® TFE-fluorocarbon resin

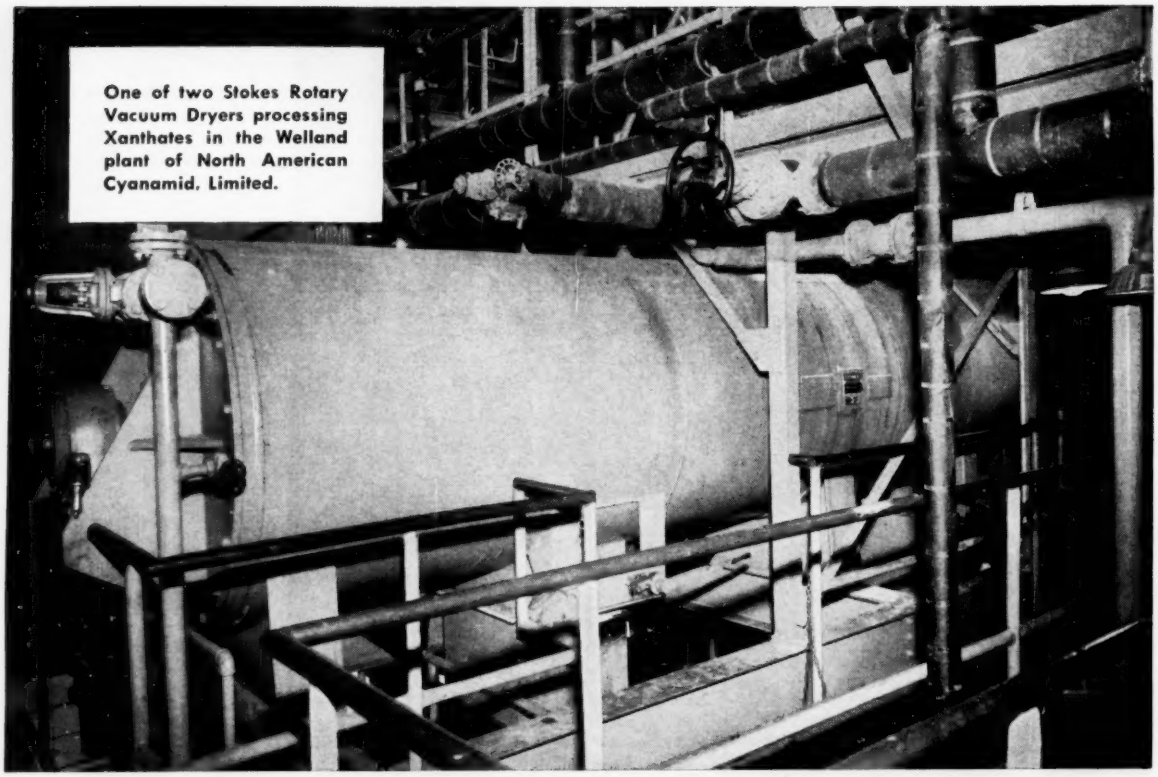
Hose made with liners of a TEFLON* TFE-fluorocarbon resin withstands the most corrosive reagents to be found in the chemical industry. Where process lines are subject to vibration, impulsing, or flexing, hose lined with Du Pont TFE resin gives superior performance. It can operate continuously at 500°F., and can be built to withstand 3000 psi. It will handle live steam without failure and repel adhesion of sticky or viscous substances. Hose lined with TFE resin is tough, flexible and outstandingly durable.

Why not find out what hose of Du Pont TFE resin can do for you? See your hose dealer or write to: E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Dept., Room 74, Du Pont Bldg., Wilmington 98, Delaware.

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. . . THROUGH CHEMISTRY

In Canada: Du Pont Company of Canada (1956) Ltd., P.O. Box 660, Montreal, Quebec.

*TEFLON is Du Pont's registered trademark for its fluorocarbon resins, including the TFE (tetrafluoroethylene) resins discussed herein.



One of two Stokes Rotary Vacuum Dryers processing Xanthates in the Welland plant of North American Cyanamid, Limited.

Stokes Rotary Vacuum Dryers process Xanthates for North American Cyanamid, Ltd.

North American Cyanamid's Welland plant, near Niagara Falls, Ont., is the only Canadian producer of Xanthates . . . a series of materials used in mining and mineral industries as flotation reagents. Stokes Rotary Vacuum Dryers play an important part in the production of these heat and air sensitive materials.

The standard "extra" features of these dryers give continuous operation that means no maintenance shutdowns—process uniformity that means more pounds of saleable products—and operating efficiency that means more profit.

- Continuous double-spiral agitators . . . fast, uniform drying . . . easy unloading . . . low power requirements.
- Heated agitator shaft and arms . . . up to 25% greater heat transfer.
- Self-aligning, tapered roller bearings . . . low power requirements . . . less stuffing box wear.
- Plug-type, flush discharge door . . . no undried pockets . . . rapid unloading.
- Process-proved options, selected according to your product requirements . . . spring loaded scrapers . . . heated or unheated, conventional or inverted dust filters . . . special construction materials . . . fixed or variable speed drums.

Stokes produces rotary vacuum dryers, rotating vacuum dryers, vacuum shelf dryers, drum dryers and flakers, tabletting equipment . . . maintains a complete laboratory to provide expert application assistance. Write Stokes, or contact your nearest Stokes office for complete information.

Vacuum Equipment Division
F. J. STOKES CORPORATION
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STOKES

LAPP ALL-SERVICE ACID PROOF VALVES

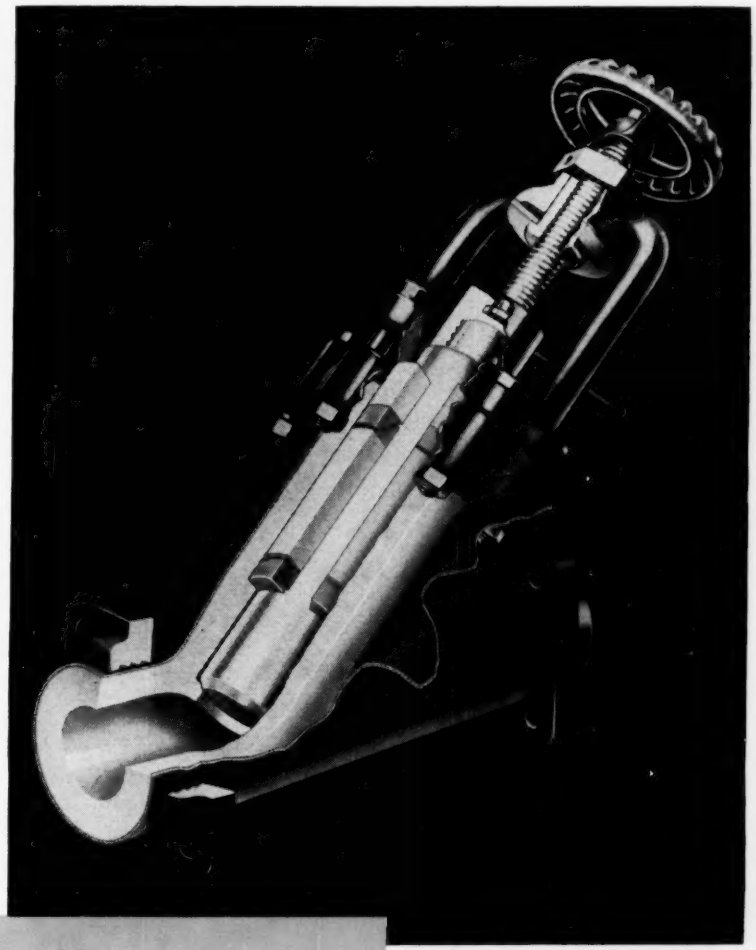
SOLID CHEMICAL PORCELAIN WITH **LAPP TUFCLAD**® ARMOR

Nothing defies corrosion like chemically inert porcelain. As made by Lapp, it is pure, dense, hard, close-grained, homogeneous and non-porous. Therefore there can be *no penetration—no crumbling* from capillary pressures—*no absorption* of liquids to contaminate later processing.

Resistance to corrosion and contamination is but part of the Lapp story; there's a *bonus* in that Lapp Chemical Porcelain costs considerably less initially than most corrosion-resistant alloys and lined equipment. *And* since it almost never needs maintenance or replacement, the economy of your purchase is further increased.

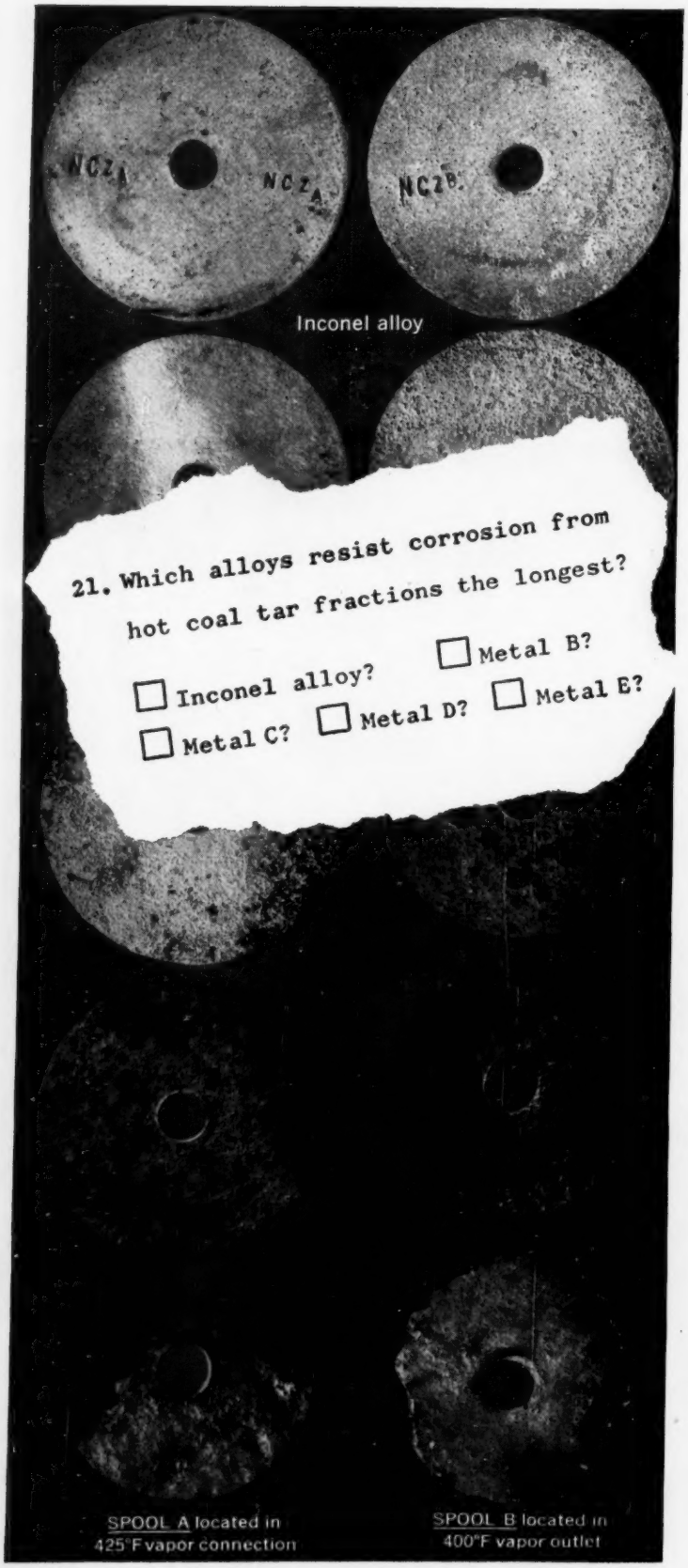
Security (protection of plant and personnel) is assured by the Lapp TUFCLAD armor. It consists of multiple layers of fiberglass impregnated and bonded to the porcelain with an Epoxy resin. Fiberglass has high strength and chemical resistance providing protection against impact damage and external thermal shock. TUFCLAD armor holds line pressures even should porcelain become cracked or broken.

***WRITE** for description and specifications for the entire line of Lapp Acid Proof Valves. Lapp Insulator Co., Inc., Process Equipment Div., 2200 Chestnut Street, LeRoy, N. Y.*



Lapp
CHEMICAL PORCELAIN

Y-Valves as shown, and Angle Valves are available in Lapp TUFCLAD Chemical Porcelain in ½" to 6" sizes. Also safety valves, flush valves, plug cocks, pipe and fittings (to 8" dia.) and special shapes.



INCO'S in-plant corrosion tests help you answer this kind of multiple-choice question

The alloy samples shown left and right were exposed to 306 days of corrosion.

They were exposed on standard Inco in-plant corrosion test racks in equipment condensing a coal tar fraction containing 5 lbs./1000 gals. of ammonium chloride at approximately 450°F. Nine different types of ferrous and nickel-base alloys were tested.

The story they tell is clear. In this *particular* equipment, with this *particular* corrosive, Inconel* nickel-chromium alloy is the alloy of choice for longest service life.

To the producer concerned, this information was useful in specifying materials for a new condenser. And, by extension, it should prove useful to other makers of coal tar products. But that's not why we're telling *you* about it.

More important by far! This demonstrates one of the Inco Corrosion Engineering services that help you answer specific questions of material selection.

Nearly always these are multiple-choice questions with, as in this case, thousands of dollars hanging on the answer. What Inco does is to go all-out to get the *factual evidence* you need for decision.

Need Help With a Corrosion Problem of Your Own?

Very often, the answer to a stubborn problem may be found in our codified files, covering thousands of case histories. Where necessary, we will help you initiate an in-plant corrosion test. Simply write to Inco's Development and Research Division. (If you like, we will send you a Corrosion Data Work Sheet, which makes it easy to outline the problem).

*Registered trademark

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street New York 5, N. Y.

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Activated Carbon

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DARCO

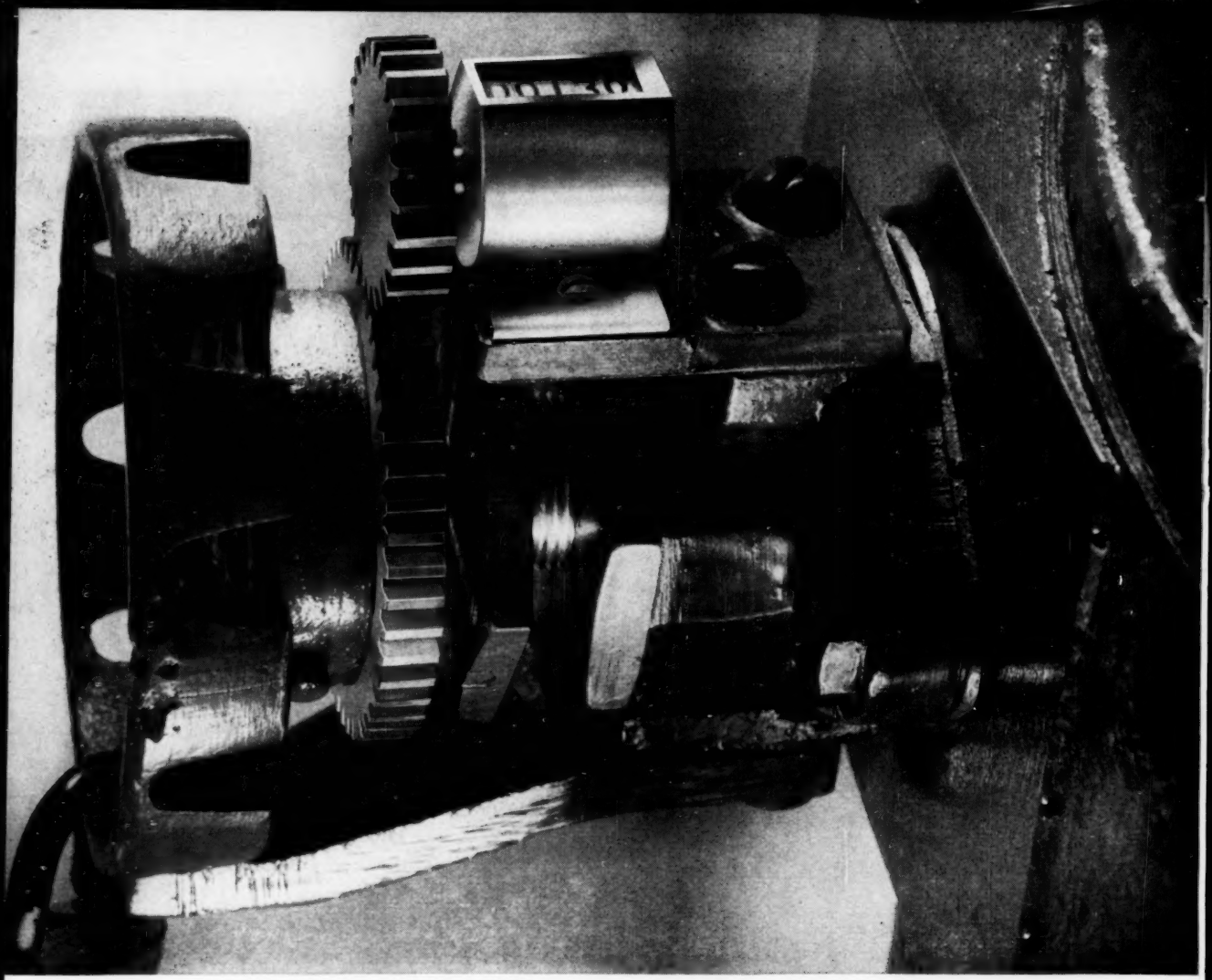
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CHEMICALS DIVISION

ATLAS POWDER COMPANY

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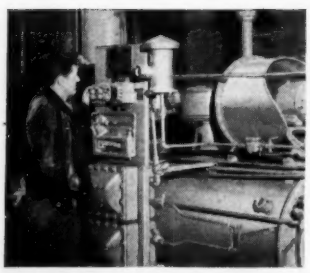
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Brantford, Ontario, Canada



Air-Gas Ratio Valve

For precise control of inert gas quality . . .

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Kemp-produced inerts are low-cost inerts. You can use them liberally, at a fraction of the cost of bottled gasses, for purging, blanketing, controlling reactions, agitation, or any of a hundred applications. You get better quality control and increased safety at the lowest possible operational cost.



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Kemp Convection Dryers



Kemp Immersion Melting Pots

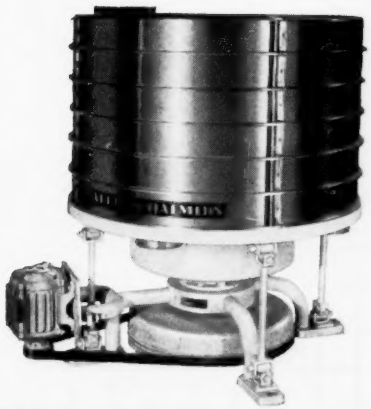
KEMP OF BALTIMORE



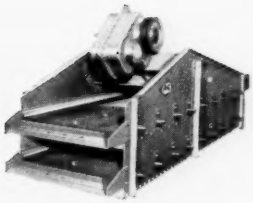
Kemp Industrial Carburetors



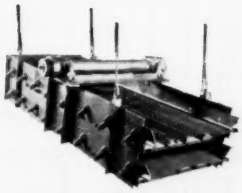
Kemp Oriad Dryers



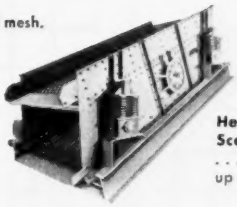
Stainless Steel Gyratory Screen
. . . for size classifications 2 to 325 mesh.



Horizontal Screens
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. . . screen apertures up to 12 inches.

SCREENS

world's widest line!

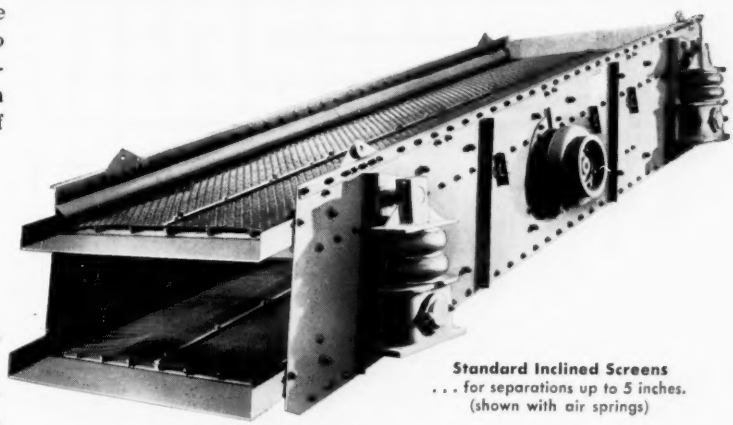
. . . From smallest to largest

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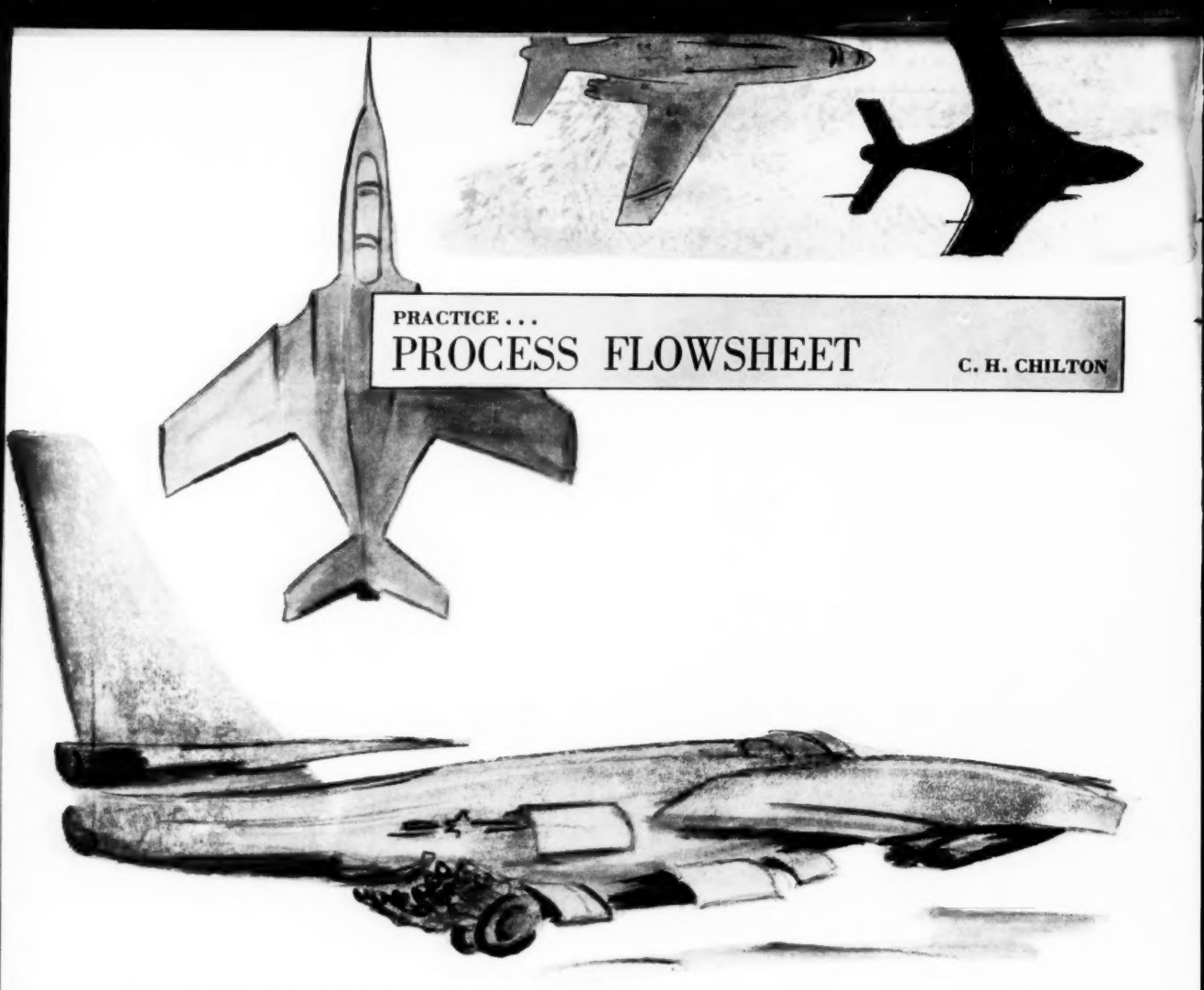


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PRACTICE . . .

PROCESS FLOWSHEET

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M-15 JATO rockets speed jet bomber take-off

For Rockets, Tried Tactics Win Solid Fuel

Astrodyne adapts compounding techniques of rubber processors, applys cost-conscious engineering at solid-propellant plant.

Currently enjoying a satellite-inspired revival is a ditty entitled "Show Me the Way to Get Out of This World 'Cause That's Where Everything Is."

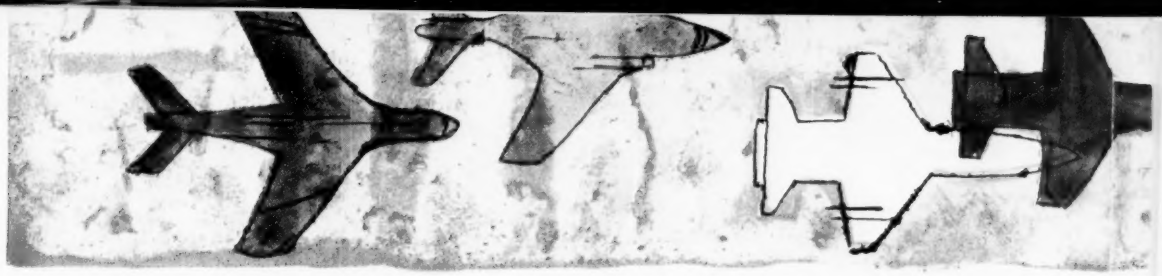
To engineers with feet on the ground, though, it's clear from an appraisal of one rocket-propellant process, that this pioneer route to the asteroids was paved with nothing more exotic than tried terrestrial equipment and down-to-earth, cost-conscious engineering.

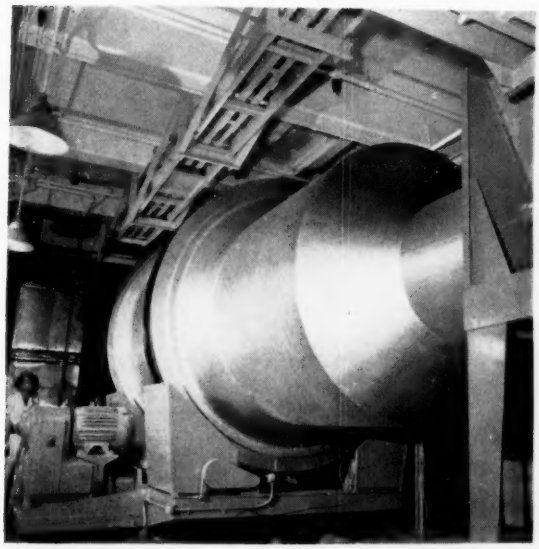
The process: Solid-propellant production line for M-15 JATO rockets (16-sec., 1,000-lb.-thrust, jet assist take-off rockets) developed by Phillips Petroleum Co. and now run by Astrodyne, Inc.,* at McGregor, Tex.

▶**Route Is Simple**—By earthy methods much like those used for compounding rubber materials, Astrodyne mixes a special copolymer rubber (dual purpose fuel-binder), ammonium nitrate oxidizer, catalyst, plasticizers and curatives, then extrudes the mixture into solid propellant cylinders (grains) of roughly 1-ft. dia., slightly less than 3-ft. length.

* Formed by Phillips Petroleum and North American Aviation.

Unfold Flowsheet

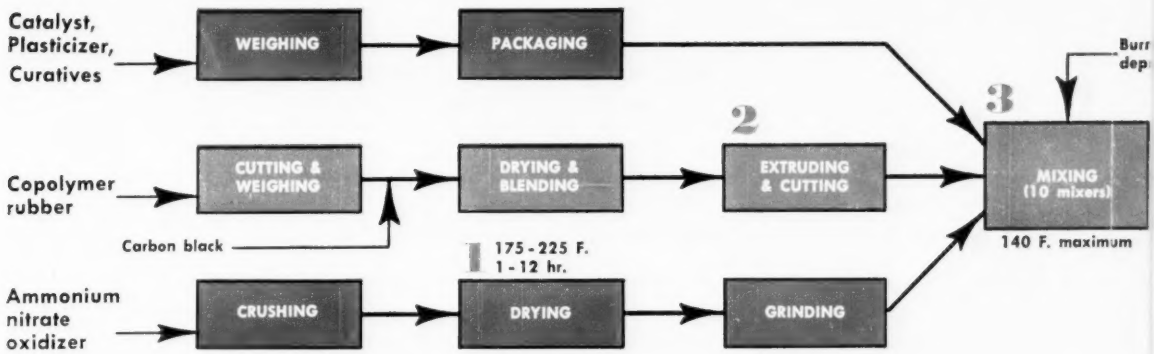




1 DRYING of ammonium nitrate in rotary dryer takes from 1-12 hr. at 175-225 F., before mixing step.



2 EXTRUDING AND CUTTING copolymer is done in extruder after blending in Banbury mixer.



Process includes such conventional steps as drying, grinding, mixing and extruding.

▶ **Pressure on Costs**—But using low-cost, readily available materials to make propellant meeting stringent Air Force specifications called for no small engineering effort.

From pilot plant to production line, M-15's history is one of far-sighted plant design, frugal quality control and cost-conscious analyses of product and production-line technique. Result has been a 14-fold slash in reject rate and a sizable cost reduction.

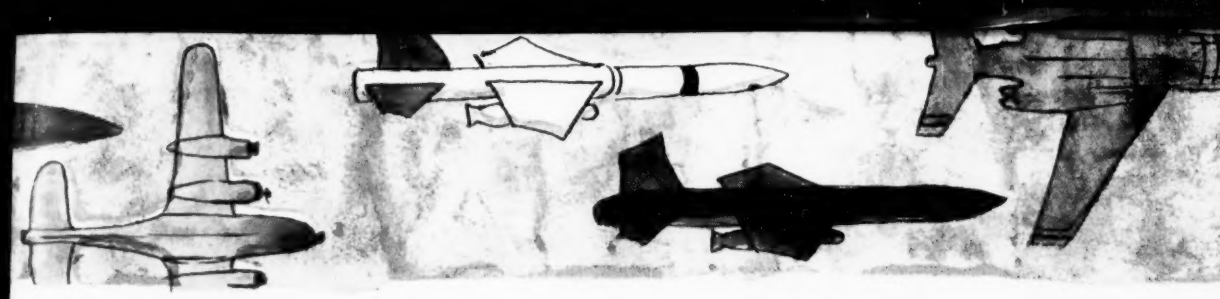
▶ **Background for Design**—Assisting Phillips in the early phases of planning and design was its know-how gained in chemical and petroleum processing.

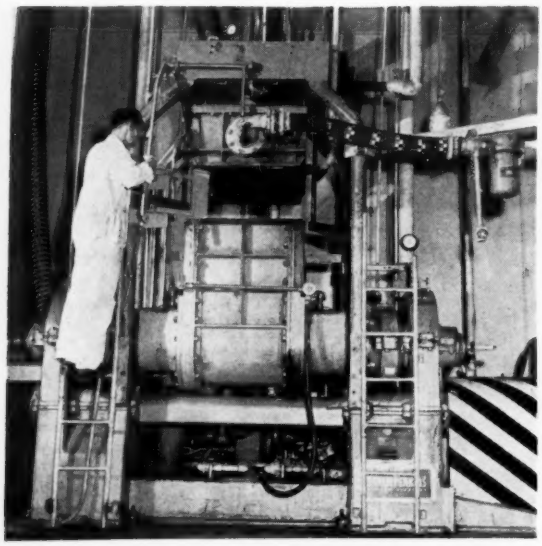
Drawing on this, the firm designed its plant for automatic operation directed from a central control area, and installed materials-handling equipment with as many automatic features as possible to streamline movement of in-process material.

Furthermore, early explosive classification tests on the propellant revealed that the only hazard is one of fire unless the material is tightly confined. Hence, the company saves the expense of conductive floor covering and shoes, coveralls and other protective clothing.

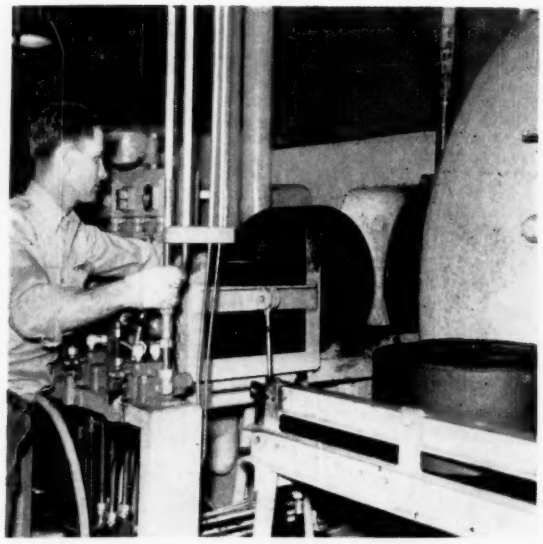
▶ **Built-in Quality Control**—Early in production shakedowns, Phillips spotted cost-paring process shortcuts and evolved more effective quality control techniques.

Initially, ammonium nitrate oxidizer was ground, analyzed for particle size, and then blended to uniform particle-size distribution. But operating experience showed that this distribution was a secondary factor in ballistics. So Phillips bypassed the

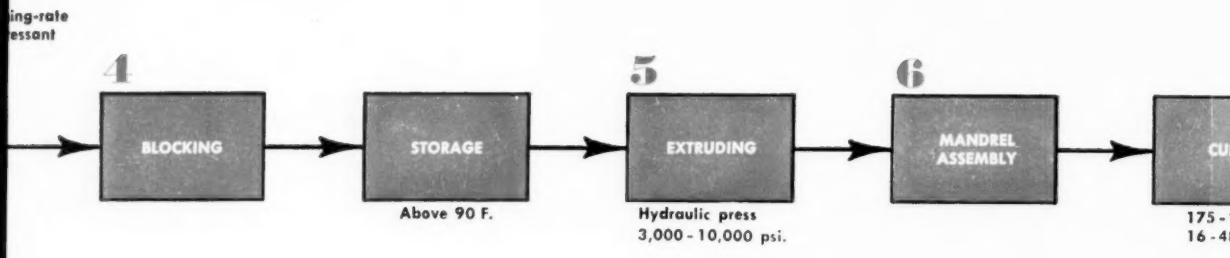




3 MIXING blends copolymer, oxidizer, catalyst in jacketed 100-gal., dispersion-blade mixer, above.



4 BLOCKING propellant in hydraulic presses puts fuel in shape to ease intense extrusion stresses.



blending step, reaped substantial savings in operating labor and maintenance.

Also, Phillips at first checked propellant burning rate on the final grains after curing and cooling. It soon found, however, that earlier sampling could save propellant which would have been discarded under the old system. It now takes burning-rate samples just after mixing so that additional processing, where necessary, can bring propellant within specifications.

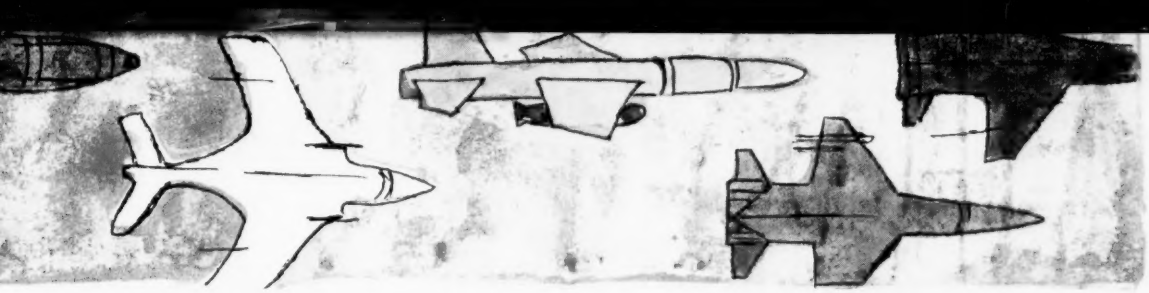
▶**New Specs Sight Savings**—Hand in hand with Phillips' dollar-saving revision of quality control procedures goes a tailoring of realistic but rigid specifications.

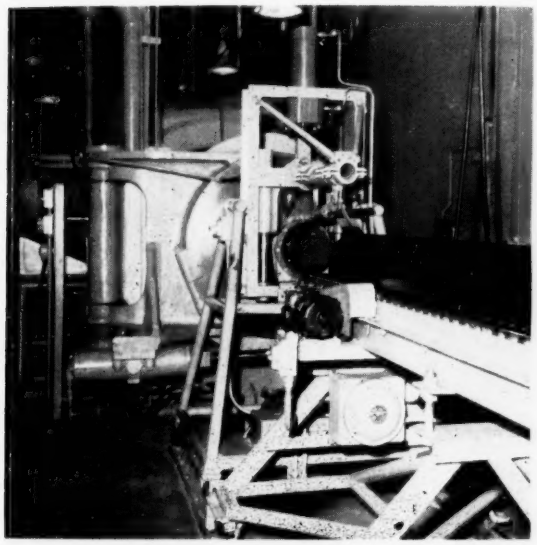
Pilot-plant experience had dictated close control over carbon black composition. But production analysis showed that variation tolerances could be doubled and still give highly satisfactory product. Since copolymer carbon-black content can be controlled within these new limits by supplier, few mix batches now need adjustment.

Fearing contamination would downgrade propellant, Phillips at first rejected grain trimmings, physically defective grains and propellant batches with faulty burning characteristics. It found, however, that all these can be reworked to give propellant just like that from 100% virgin materials.

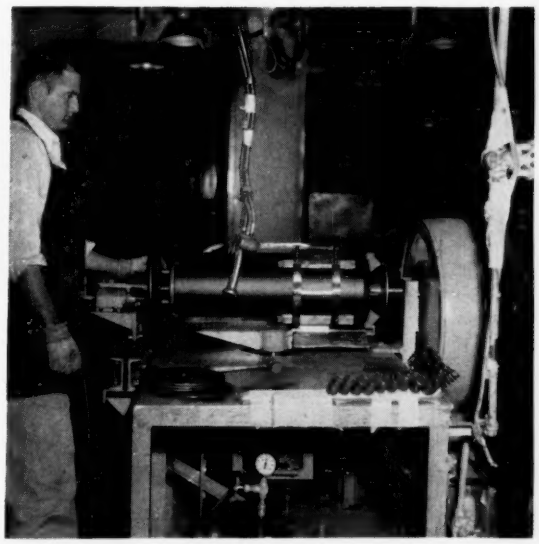
▶**How Process Works**—Fertilizer-grade ammonium nitrate prills (without coating) are crushed in a rotary crusher, dried at 175-225 F. for 4-6 hr. (depending on the amount of moisture) in a rotary dryer, and ground to required particle size in a hammer mill.

Ground nitrate, added in increments, copolymer and other ingredients are brought together in a 100-

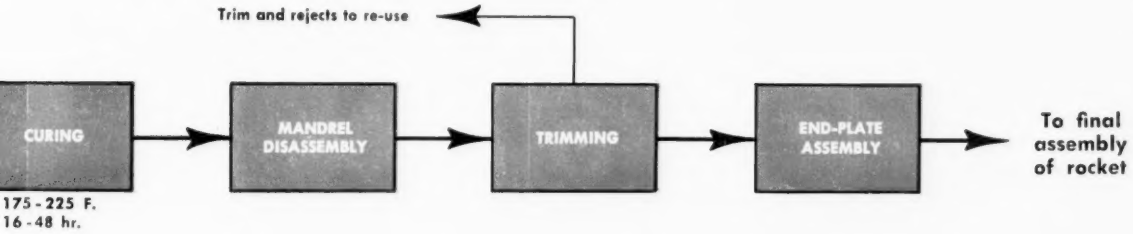




5 EXTRUDING squeezes out propellant at a rate of 10 ft./min., gives fuel cored, cylindrical shape.



6 MANDREL ASSEMBLY operator tacks on end plates and rubber side strips before curing.



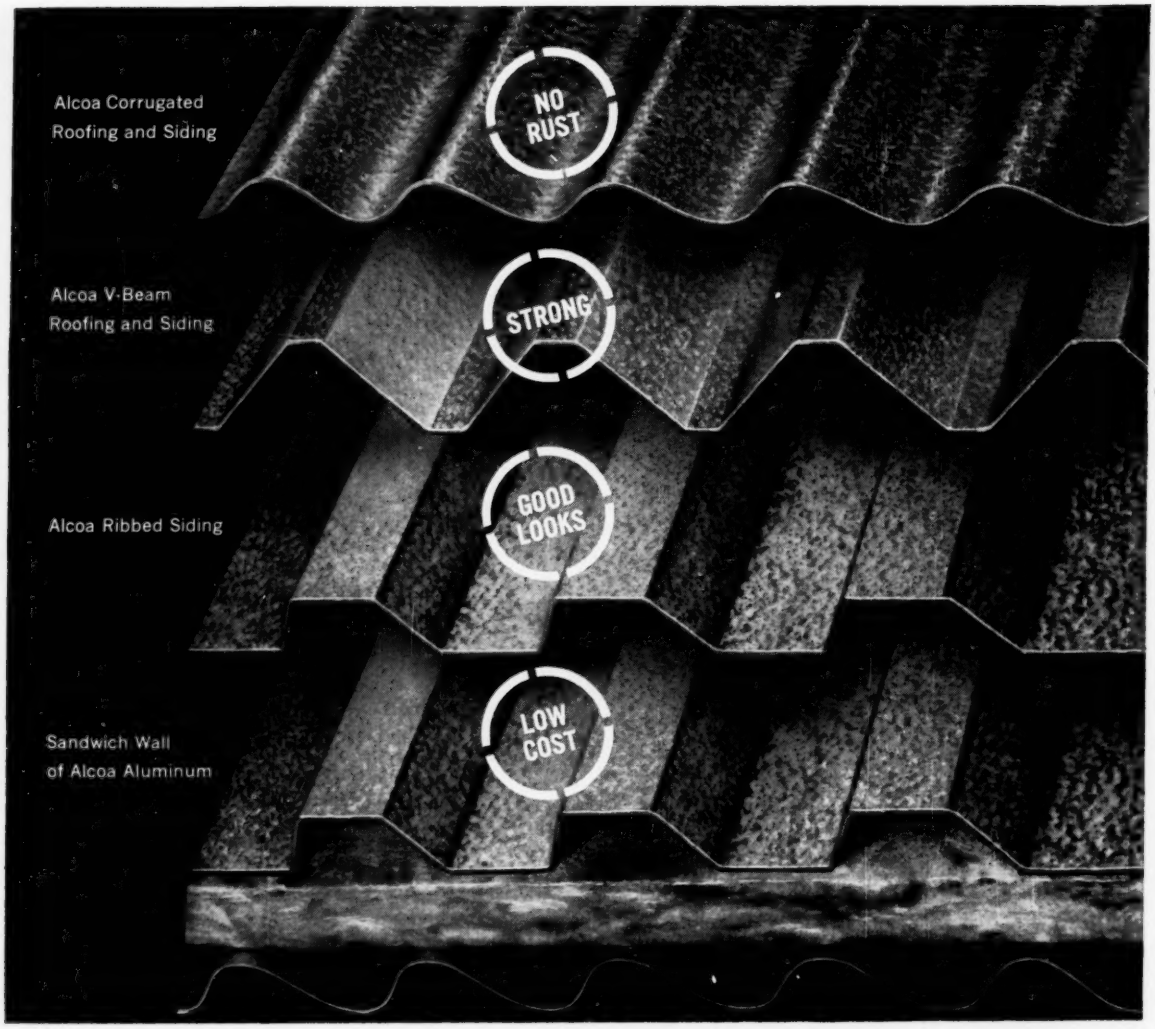
gal. dispersion-blade mixer and mixed for a period of 30 min. to 2 hr. In mixing, oxidizer and catalyst are dispersed in a continuous rubber phase; longer mixing time means finer dispersion and, hence, faster burning rate.

▶**A Key Step**—Here, by varying mixing time and adding a burning-rate depressant, Astrodyne gains positive control over burning rate of the final JATO propellant. Mix temperature is held to a maximum of 140 F. to avoid scorching the propellant. Heat generated during mixing drives off moisture. Mixers are jacketed for cooling water circulation and fitted with vacuum covers. Astrodyne mixes under vacuum during part of the cycle to remove air bubbles from propellant batches.

▶**Blocking, Extruding**—From the batch mixers, propellant goes to hydraulic presses for blocking. This eases loading on the extrusion press. To prevent explosion that might be caused by heating air, blocking baskets are evacuated before exerting force.

Extruders, operated by remote control from behind a concrete wall, push out blocked propellant into extruded form at a rate of 10 ft./min. Extrusion pressure on the propellant may vary from 3,000 to 10,000 psi. Propellant grains are automatically cut to desired length.

▶**Cure and Assemble**—After extrusion, grains are given a first cure and are trimmed to exact length. Grains journey through curing ovens (175-225 F., for 16-48 hr.) on mandrel assemblies of metal end plates and rubber strips. Grain surfaces that don't burn during firing are coated with inhibitor similar to propellant binder and grains are ready for case loading and final assembly.



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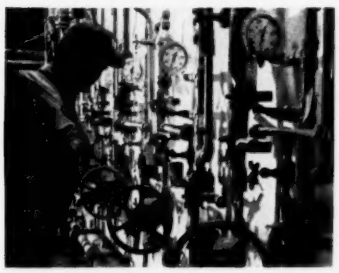
Why external recalibration is important to users of industrial thermometers

Sometimes it is necessary to recalibrate thermometers in industrial installations due to severe shock from rough handling, or to calibrate for extreme accuracy at any point on the scale for special work range.

To recalibrate the ordinary bimetal thermometer, you must remove the dial glass and move the pointer by hand. You will achieve the desired recalibration of course, but a number of undesirable things may also result. First of all, the instrument's air-tight seal is automatically destroyed in the removal of the dial glass. Secondly, in forcing the pointer, the pointer shaft may become bent or twisted.

Should the pointer shaft become bent even slightly, it can cause the pointer to stick due to improper alignment of the bimetallic shaft on its bearing surfaces. The obvious result, of course, will be inaccurate readings and necessary repair or replacement of the instrument. *None* of these things can happen with the RMC external recalibration device.

A simple dial-reset screw, located on the back side of RMC industrial thermometers, permits recalibration without opening the instrument in any way. This external recalibration feature is *exclusive* with RMC, along with true dry-air hermetic sealing.



SHIPPINGPORT, Pa.—Heavy-duty dial thermometers play an important role in the operation of the world's first full-scale atomic-electric generating station devoted exclusively to civilian needs. These thermometers, manufactured by RMC, can be recalibrated externally. The plant is a joint project of Westinghouse Electric Corporation, Atomic Energy Commission and Duquesne Light Company of Pittsburgh.

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RMC-LINDSAY PRESSUREGAUGES indicate pressures in ranges 0 to 1,000 psi., up to 0 to 15,000 psi., with retard scales available. Multiple coil, helical Bourdon tube type, with pointer attached direct—no linkages or pivots. Can withstand extreme shock, vibration, temperature, or overpressure and maintain consistent accuracy.

Write, wire or phone—tell us your requirements for indicating instruments, and let RMC engineering skill go to work for you. ROCHESTER MFG. CO., 113 Rockwood St., Rochester 10, N. Y.



This maintenance engineer is recalibrating an RMC bimetal dial thermometer by means of the exclusive RMC *external* dial reset screw—a simple on-the-job operation with RMC thermometers.

RMC external recalibration device saves thermometer's hermetic seal

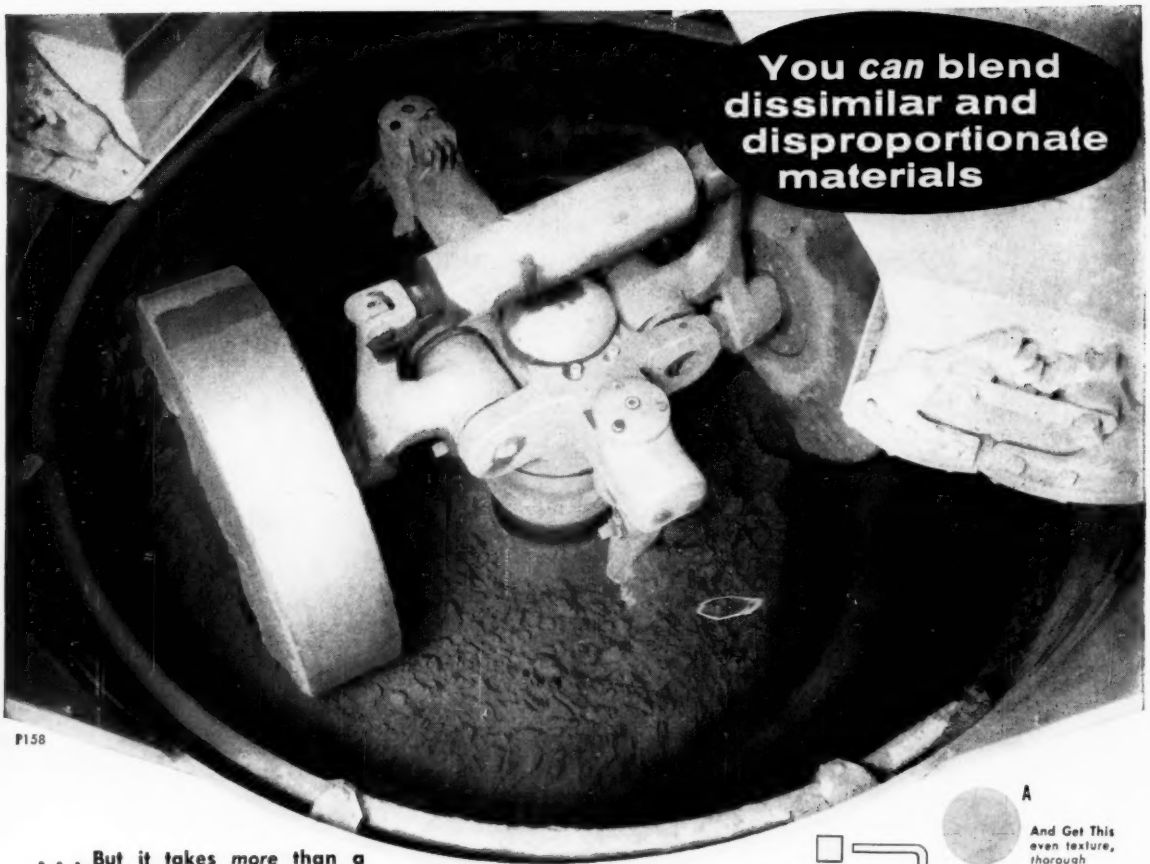
With this *external* dial reset screw you can recalibrate your RMC thermometer easily and safely, should it ever be necessary. The all-important hermetic seal cannot be destroyed and there is no chance for damage to the critical pointer shaft. You get the *only* bimetal industrial thermometer that provides for *external* recalibration when you specify RMC.

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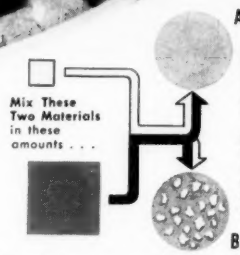
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Chemical Engineering

Practice

For rockets, tried tactics win solid fuels 126

This route to propellants—which mimics rubber-making techniques—was paved with nothing more exotic than earthy equipment and plain, cost-conscious engineering.

Know your way around high-temperature nonmetallics 135

You don't have to be a witch doctor to know how to select and use these materials of construction. This roundup will put you on top of design and application problems.

More on radiant heat design 151

Last issue, we talked about the theory of radiant and infrared heating. Now we apply that theory to the design, selection, and cost of equipment to perform a given job.

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Chemical Engineering
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Pyrolysis tubes
Mannheim furnace

Taking the Black Magic Out of . . .

High-Temperature Nonmetallics

Here's the why, how and where for better application of the nonmetallic inorganic materials of construction.

ROY W. BROWN, Manager, Technical Service, Refractories Div., Carborundum Co., Perth Amboy, N. J.*

Industry is reaching for the heat of the stars. With a blinding blast, fusion, fission, rockets and missiles have broken through to the blazing world of high temperature.

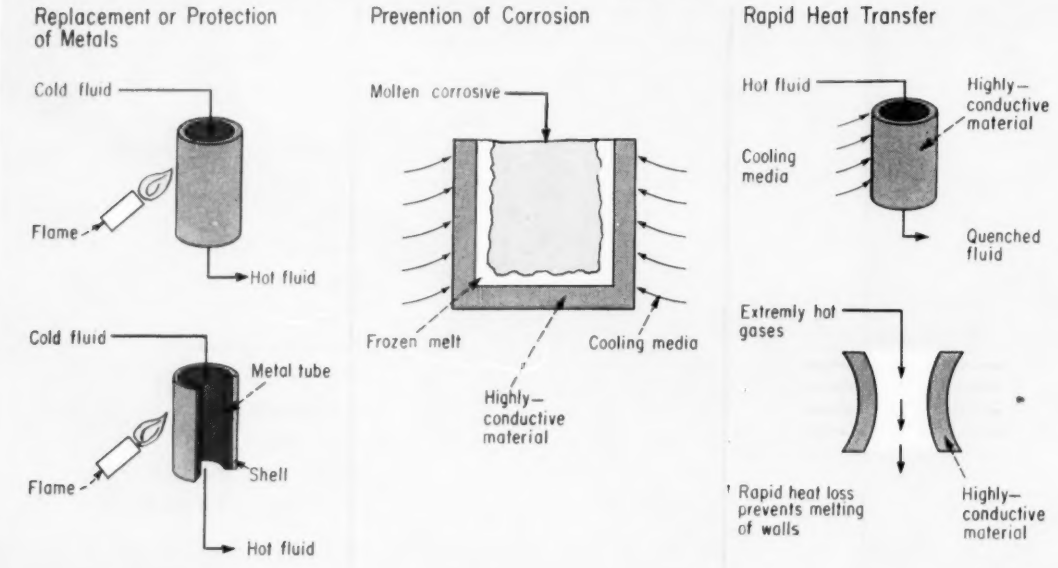
Rocket combustion takes place in that rarified world of over 5,000 F. with some burner temperatures even going as high as 9,000 F. Direct oxidation of nitrogen becomes a reality at 4,000 F. Phosphorus is burned at 3,600 F. in manufacturing phosphoric acid. Quite suddenly, the chemical engineer has found himself faced by the problems that come with high-temperature processing.

We've all heard about the glamorous new materials being designed to meet these conditions, but, all the excitement and shouting isn't much help to you, the man with a materials problem to solve—now.

Higher and hotter have become the processing by-words of today. Carbon black, acetylene, partial oxidations, water gas and melting operations. These are some of the many high-temperature situations

* Meet your author on p. 187.

Some Examples for the Use of Nonmetallic Inorganics



in the chemical industry where better use can be made of existing materials.

• Consider the case of the chemical engineer who is faced with a problem of alloy tubes slumping in a heating furnace at 2,200 F.

• Consider the case of the chemical engineer who is having refractory reactor walls disintegrate at a fairly low temperature —below 2,800 F.—in a hydrogen atmosphere.

• Consider the case of the chemical engineer who wants to protect some necessary and valuable metal parts from direct flame impingement without reducing the process efficiency.

• Consider all these cases and yours too.

You don't have to be a witch doctor to know the why, how and where of better selection and application of nonmetallic inorganic materials of construction. The problems are many and varied. The field is wide. How you can turn these unfamiliar materials into your everyday workhorses is all here.

Coming

This report is the first in a series covering high-temperature materials of construction. Others to follow will deal with ultra-high-temperature and middle-range nonmetallics and high-temperature metals.

Because of the temperature problems the process industries face today, we'll confine ourselves to the materials that work best between 1,500 and 3,500 F. Emphasis will be placed on the engineering characteristics, good and bad, of a host of materials now available to the chemical engineer.

Use Heat Conductivity

When you're ready to select a heat-resistant material, one of the most important properties you'll deal with is thermal conductivity.

Unfortunately, most people think that nonmetallic inorganic materials are only good as insulators while the metals are great conductors of heat. The truth is, these nonmetallics have a range of thermal conductivities—from insulation to conduction—far greater than any other type of material.

Cast iron and alloy steels are standard materials of construction in the process industries. They have exceptional ability to transmit heat but the ability decreases at higher temperatures. This decrease coupled with a use limit of around 1,500 F. limits the metals in the higher temperature ranges.

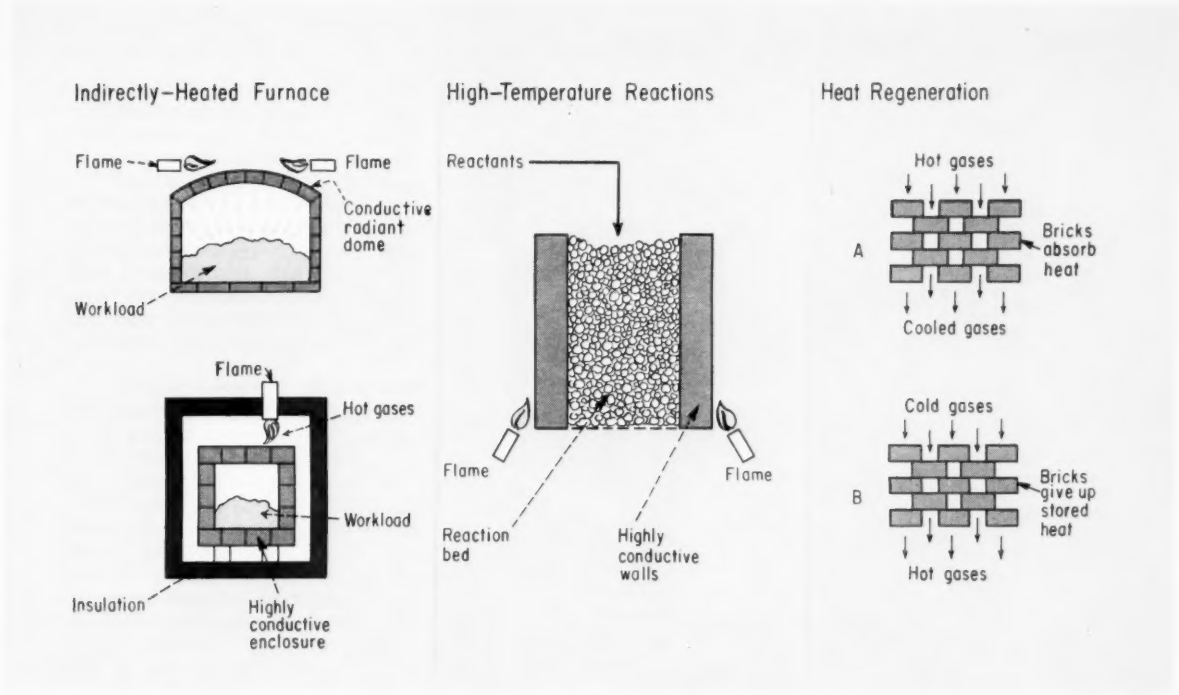
For temperatures above 1,500 F. we can look to electric furnace materials such as alumina and silicon carbide. High heat conductivity is the most outstanding property of some of these materials.

For example, the exceedingly high thermal conductivity of carbon is widely exploited in the chemical industry with products such as Karbate coolers. However, carbon's main problem is its susceptibility to oxidation and, therefore, its uses are limited. Silicon carbide, another high conductor of heat, will transmit 109 Btu./(hr., sq. ft., deg. F./in.) at 2,200 F.[12] This value is roughly 11 times that of fireclay and about 70% that of the chrome-nickel steels.

Silicon carbide also oxidizes under certain temperature conditions, although at a much slower rate than carbon. These properties allow you in many places to select a slightly less conductive but more chemically stable material—even though your specifications call for a very high thermal conductivity. It's interesting that the thermal conductivity of many of these products, such as alumina, is still twice that of fireclay or mullite.

Thermal conductivity values of the nonmetallic inorganic materials of construction of interest to you in the chemical industry are given in Fig. 1.

Some ways to take advantage and make better use of the wide



variations in the thermal conductivity of nonmetallics, are shown in the accompanying figure and described below.

For Indirect or Muffle Heating

With indirect or muffle heating there's a complete separation of the heated materials and the heating media.[5] High-conductivity materials are pretty important in this application. You want only a minimum thermal gradient to transmit heat rapidly through a wall to the workload.

As an example, the thermal gradient through a 1.5-in. thick wall of fireclay, with an inside work chamber temperature of 1,500 F., is almost 850 F. But, a temperature difference of only about 70 F. can be had by replacing the fireclay with a higher conductive material such as silicon carbide.

Decreased thermal gradient results in: lowered combustion chamber temperatures; improved fuel efficiency and combustion; and minimized refractory difficulties.

Many Process Examples Exist

Some of the process uses of high-conductivity materials for the indirect heating of solids are listed below.

Mannheim Furnaces — Between the combustion chamber and the work chamber is a dome of silicon carbide. Sulfuric acid and salt cake are fed into a reaction chamber that's externally heated through a radiant silicon carbide dome. Products of this process are muriatic acid and salt cake.

Without the use of a highly conductive material, such as silicon carbide, a much higher combustion chamber temperature would be required to drive the heat through. High temperatures and corrosive conditions set up a situation where radiating metal domes can't be considered.

Monsanto-Ross-Wilde Process— In this process, a multiple-hearth furnace is used. Sulfur in heavy acid sludges is recovered as SO_2 by mixing the sludge with coke and rabbling.

Radiating domes made of silicon carbide are fired indirectly and sufficient heat is radiated to the decomposer to break down the spent acids into SO_2 and SO_3 gases.

Recirculation of the gases to conventional sulfuric acid plants helps to maintain feed stock for petroleum products processed by acid. By-product coke is also salable for general petroleum coke purposes.

Vertical Retorts—In the zinc industry, vertical retorts are used in the reduction of ore to metallic zinc. Zinc ores are briquetted with coke and charged in through the top of this externally heated retort. As the charge descends between silicon carbide walls, the coke reduces the ore and zinc vapors distill into suitable containers.[6]

End compression is used on the retort walls for maximum joint tightness. Heat transfer walls are 25 to 30-ft. tall and up to 6-ft. wide. Width of the slot used depends on the material being calcined. These reactors can operate continuously or intermittently.

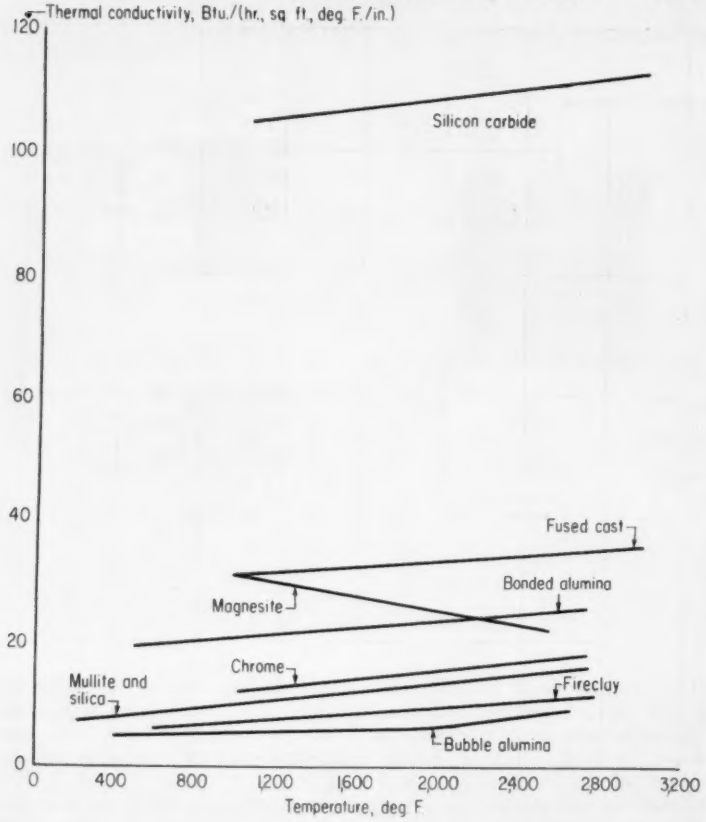
Reactors are also in use for calcining charcoal and reducing cobalt and chrome ores. Similar units calcine green petroleum coke and can be easily adapted to externally heated fluidized-bed work.

Gases and Liquids Can Be Heated

There are many ways you can take advantage of high thermal conductivity bodies when you're trying to indirectly heat a fluid. Steam generation is a good example where a high thermal conductivity material is used to protect metal tubes from excessive overheating. As a jacket on the metal tubes, the nonmetallic still allows a rapid transfer of heat to the water in the tubes.

Another way to make use of the high thermal conductivity of some of the nonmetallic inorganics is by directly substituting them into units where the temperature is too high for efficient use of a metal.

Use Differences in Thermal Conductivity Values Fig. 1



An interesting piece of equipment, incorporating this idea, is shown in Fig. 2. Designed by the Gas Machinery Co., it performs a wide variety of operations at high temperatures. Its main use is in the reforming of hydrocarbon feed stocks.[16]

Continuous sections of silicon carbide tubes, shown in the photograph accompanying Fig. 2, are put together in a one-directional gas-flow unit, 25 to 30-ft. tall with the usual reversing valves and controls eliminated. The unit is simple to operate because it's continuous. Reactants are fed at the top into the refractory tubes and pass down into a common quenching or collection system.

In a similar case, engineers at Columbia University[7] calculated a reactor to convert, in externally heated tubes, a feed stock of 75% propane and 25% ethane to a mixture of 50% ethylene.

They determined that 670 ft. of alloy tubing are required to achieve the proper conversion at 1,500 F. Using silicon carbide tubes instead, and raising the temperature to 3,000 F., the reaction is possible in only 67 ft.—approximately 10% the length of alloy tubing required.

These calculations assumed a pressure of 70 psia. Unfortunately, silicon carbide isn't completely impermeable and can't withstand a differential pressure much greater than 5 to 10 psi. without leakage. Therefore, another set of calculations were made at a pressure of 15 psia.

At the lower pressure, conversion to 50% ethylene required approximately 71 ft. of silicon carbide tubing, reducing pressure by 55 psi. and adding only 4 ft. of silicon carbide.

At the present time, 70-ft. long tubes of silicon carbide aren't available. However, these data present some interesting problems for the chemical industry to investigate in the design of tube return bends and compression joints so that such lengths become available.

Lengths of 4 to 6 ft., with return bends, can be externally fired with a satisfactory conversion of hydrocarbon feed stocks and completion of chemical reactions. This allows the use of temperatures considered impossible at one time in direct-fired tube applications.

A twist on the above application is using silicon carbide as a fuel-fired radiating tube. Some recent work gives the data on tube heat transfer rates, maximum use temperatures and allowable heat release rates inside such tubes.[8]

Heat Can Be Dissipated Rapidly

In many processing applications, for one reason or another, it's essential to dissipate heat rapidly.

In tunnel kilns, alumina wall panels are used to take heat away in the cooling section. In the same way, electric circuit breaker units use silicon carbide shields to dissipate heat from millions of recurring flashes without decomposition.

Some of the more interesting examples of heat dissipation in the chemical industry are:

Regenerator Checker Chambers—High thermal conductivity and emissivity are prerequisites for a material to serve as a heat storage medium for high-temperature operations.

At a given temperature, the total amount of heat that can be stored in a regenerative setting is a function of the weight of the materials used and their specific heat. However, for fast cycle operations, the rate at which heat can be absorbed and released is a function of the thermal conductivity and emissivity of the materials used. The great differences available in rate of heat absorption are shown in Fig. 3, where the time for saturation of firebrick is shown to be much longer than of silicon carbide.

Simple substitution of one material for another in checker settings isn't satisfactory in itself. Equipment in which the checkers are used must be rebalanced and the cycles adjusted to take advantage of the higher available heat storage capacity.

Hydrocarbon Reformers—Where a reforming process is important, bonded alumina is used because of its combination of high density and specific heat, and its chemical stability. Important design features overcome the lower thermal conductivity that bonded alumina presents.

The Hasche fluted-tile regen-

erator,[18] shown in the photograph on the next page, is used in the Wulff process for making acetylene[5] and in several other types of hydrocarbon reforming processes.

Twin regenerative settings of thin alumina checkers form the heart of the operation. These settings permit close control of residence time. Cracking stock with steam and air is reformed in one-half of the furnace, quenching is accomplished in the other. Sensible heat removed from the gas is consumed in the endothermic reactions of reforming when the cycle is reversed. There's little, if any, use of auxiliary heat.

Hydrogen-Chlorine Burners — High temperatures are involved in the production of HCl gas by burning hydrogen and chlorine in a confined combustion area. Heat in a unit of this sort is dissipated through tubular linings made partially of silicon carbide.

Silicon carbide has a considerable advantage over fireclay or acidbrick because of its high conductivity and ability to dissipate heat away to the water-cooled metal walls. Temperature reduction of the exit gases reduces their volume and allows greater efficiency in the condensing and treating areas of the process.

In one chemical company the substitution of approximately one-half of their 4-in. lining of refractory material with silicon carbide resulted in a 60 to 70% increase in production.

Discussion of the uses of high-conductivity materials in either heating or heat dissipation should stimulate your imagination to adapt these materials to "impossible" situations.

For example, molten cryolite will quickly dissolve any refractory nonmetallic inorganic material. This is avoided in electrolytic aluminum cells by externally cooling thin walls made of silicon carbide. Molten cryolite, in contact with the lining, is frozen so the melt is essentially contained within itself. It's true there is a decrease in overall furnace thermal efficiency but this is more than compensated for by the increase in furnace life.

Insulation: the Other Side of the Coin

Most commercial nonmetallic inorganic materials have average insulating properties. In this category are plain and alumina-enriched fireclay, basic materials, converted kyanite, electric-furnace mullite and silica.

There are materials that have insulating properties at high temperatures and some thought should be given to this side of the thermal conductivity coin. Markets exist in the chemical industry for insulating firebrick, insulating silica brick and a variety of insulating aluminas.

It's often imperative that a lining material not only have low thermal conductivity but also low heat capacity. This indicates a slow rate of heat penetration or absorption.

Of interest here, particularly for extremely high-temperature work, is a lightweight material made from bubbles of fused alumina.

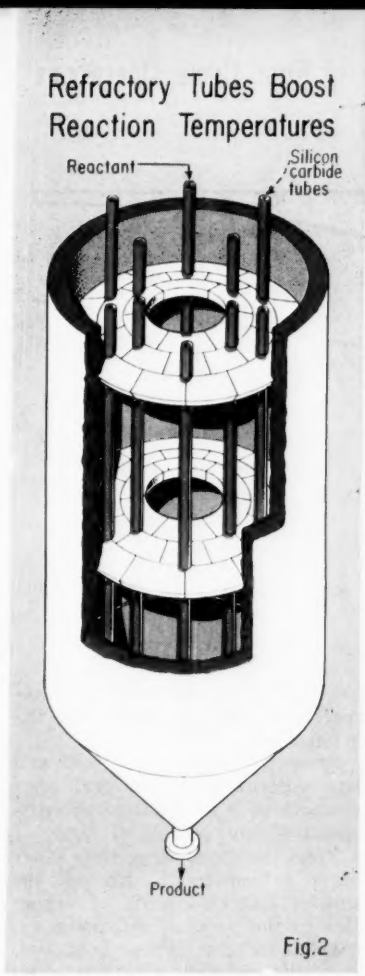
Aluminum oxide is melted in an electric furnace and fed into a gas or air stream that blows the material into bubbles. These bubbles are used as grog for bricks and castables that have unique properties of strength and chemical stability at extremely high temperatures.

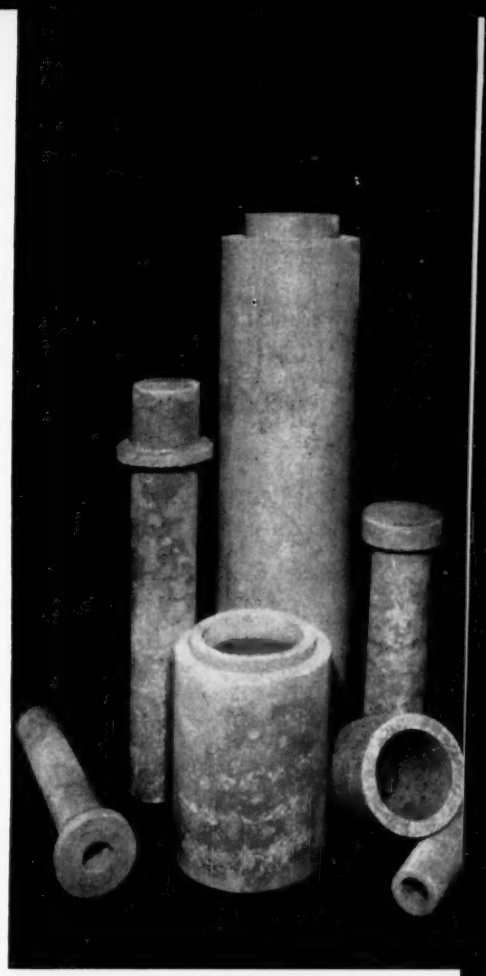
Using a hollow grog of this sort is an advantage over the conventional insulating firebrick materials since the bubble material has more volume stability and less shrinkage (due to the high-temperature structural stability of the bubble itself).

A similar material is a lightweight fused zirconia bubble. When introduced into a body, the total density becomes 115 to 125 lb./cu. ft. This compares with over 200 lb./cu. ft. density for regular stabilized zirconia bodies.

Zirconia materials are excellent insulators. Their low thermal conductivity, approximately half that of fireclay brick, is unusual in view of the high bulk density—almost twice that of fireclay.

One off-shoot of the alumina bubble-blowing program was the development of fibers called Fiberfrax.[20] This unique material consists of 50% alumina and 50% silica. It can be successfully and steadily used from 1,500 to 2,300





Consider Rapid Heat Saturation for Fast Cycle Operations

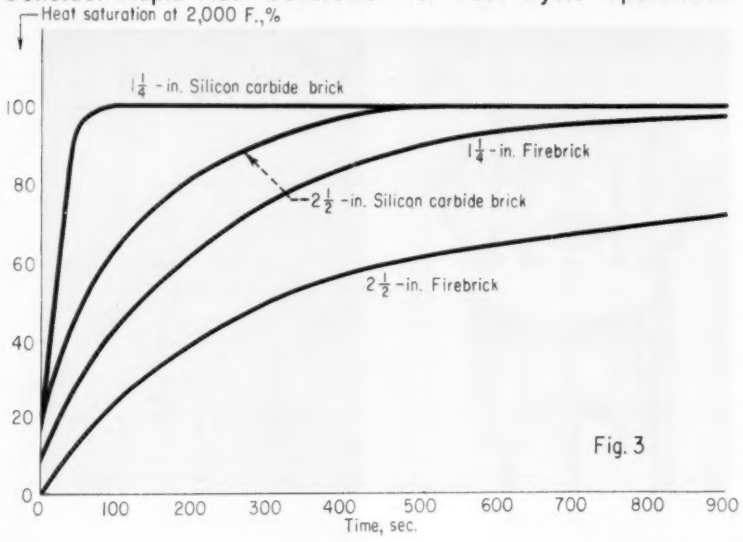


Fig. 3

F. and it has a melting point above 3,000 F. This opens up considerable areas for use above and beyond the previously defined limits for mineral wool or asbestos.

Hot Strength Varies

A second major physical requirement is hot strength—the ability to stand up under load at elevated temperatures. Load sources can develop from external weight, such as a furnace charge, or even from stresses within the structure itself.

Hot strength varies with the particular material and conditions of its use. Many nonmetallics give satisfactory service in definite ranges of temperature and load. Above these temperatures and loads they become increasingly susceptible to deformation and ultimate failure. In considering an installation that'll have loads at elevated temperatures, you should consider the strength of the proposed materials at these same elevated temperatures.

Tests Tell You How to Do It

Designers of process equipment have to know how materials of construction will behave under load over a sufficiently long period of time and over wide ranges in temperature. Unfortunately, most load tests don't serve the whole purpose since they only measure the change in length after cooling and tell nothing of behavior during heating up, total expansion or ability to carry a load at high temperatures.

To guide you in selection, both 100-hr. and short-duration tests are shown in Fig. 4 and the accompanying table.

From the 100-hr. load test, you can determine the overall hot strength of a material to be operated for long periods of time.

From the short-range tests other basic information, such as the amount and uniformity of expansion to the point of maximum expansion, is obtainable. Low, uniform thermal expansion minimizes difficulties with the mechanical distortion of a structure.

You should know the temperature where expansion ceases; here, softening under load begins. Many of the nonmetallics begin to soften at temperatures below this, although they may be satisfactorily used above their softening points, with some caution.

Shrinkage that occurs during the period a material is under load is also of great importance. Some common materials held for 90 min. at 2,732 F. (1,500 C.) behave as follows:

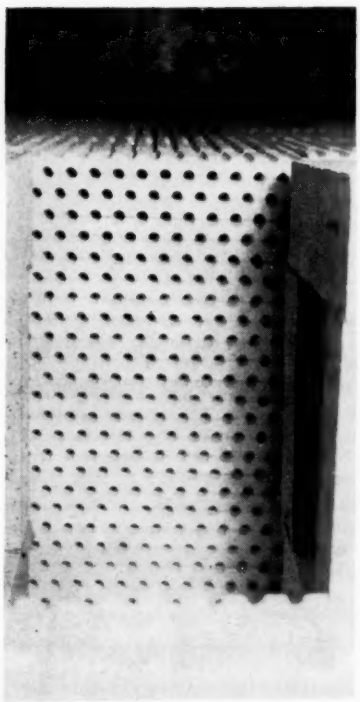
Material	Expansion
Chrome	+ 1.06
Silicon carbide	+ 0.78
Mullite	+ 0.78
Bonded alumina	+ 0.13
60% Al_2O_3 fireclay	− 8.99
Superduty fireclay	−10.5

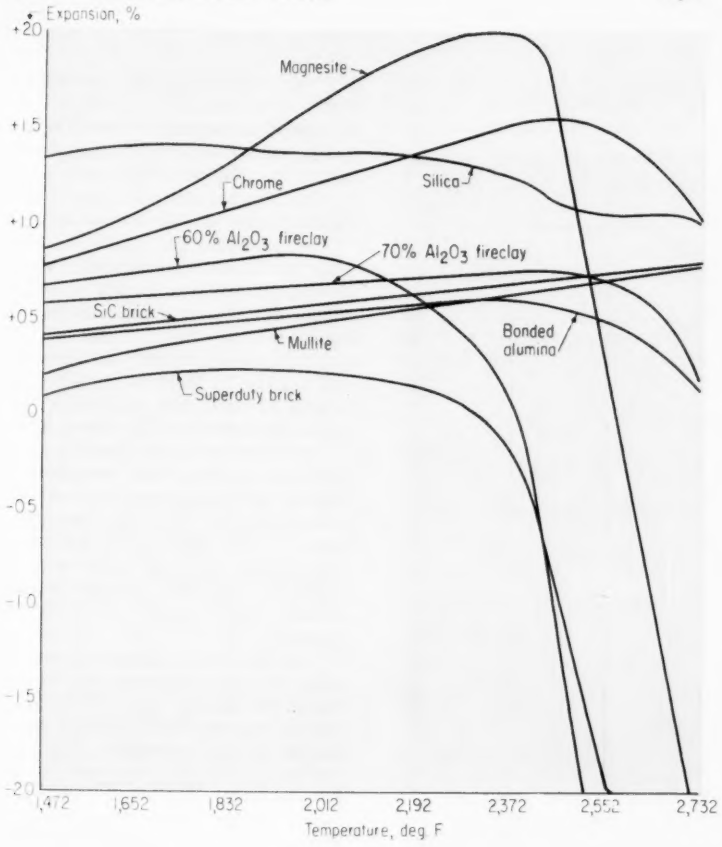
Contraction of a material can be interpreted directly in terms of furnace life. Contractions of 5% are classed as failures since this is a $\frac{1}{16}$-in. slump of a 9-in. long brick—usually enough to lose keying, wedging or arching action in a modular unit.

By considering both the long- and short-duration tests, you can make a pretty-sure estimate of how a high temperature material will stand up. Considered separately, the tests can be misleading. For example, silica shows excellent load-bearing ability in the 100-hr. tests and is widely used as the crown or cap in glass furnaces. However, a rapid heating-cooling cycle will affect its service life. Therefore, silica isn't recommended as a lining in furnaces that go up and down in temperature. Field experience backs up this statement that's not obvious if you only study one of the tests.

Balance Properties for Best Pick

Many times when you're designing with nonmetallic inorganic materials, properties have to be balanced against each other in making the best pick of available





Sustained Load Test

	Load, Psi.	Deformation After 100 Hr., % Temperature, Deg.F. 2,192	2,462	2,732
Fireclay	6.25	0.30	3.9	....
	12.5	0.23	4.3	....
	25	0.32	11.3	....
	50	....	>10.3	....
Semi-silica	6.25	....	1.19	....
	12.5	....	3.14	....
	25	....	5.03	....
	50	1.19	....	....
Silica	6.25	....	....	....
	12.5	....	....	Nil
	25	....	....	0.13
	50	....	....	0.25
High-alumina-fireclay	6.25	....	2.8	....
	12.5	....	2.4	....
	25	0.87	7.7	....
	50	1.30	9.9	....
Bonded alumina	6.25	....	+0.20	2.51
	12.5	....	+0.04	3.73
	25	....	0.25	8.68
	50	....	1.08	10.58
Mullite	6.25	....	....	....
	12.5	....	....	....
	25	....	....	....
	50	....	Nil	Nil
Silicon carbide	6.25	....	....	0.40
	12.5	....	....	0.40
	25	....	....	0.58
	50	....	....	0.78

construction materials. In the design of pebble heaters, we run into this case. The more obvious and stronger selection is by-passed in favor of a material that gives better all-around service. Why? Well, let's take a look at pebble heater construction.

Pebble heaters are used for superheating steam, preheating air, cracking light hydrocarbons and producing ethylene and acetylene from an ethane-rich gas.

In these units, the temperature is so high that hot strength of component parts is most important. Passage of either the products of combustion or the pebbles themselves has to be carefully engineered, since great stresses are placed on the individual parts. Here, not only the strength of materials is important but also their volume stability (maintenance of dimension at high temperatures for long periods of time).

An obvious choice for the material of construction is bonded alumina. Components made of this material have a higher transverse load strength, higher modulus of rupture and greater refractoriness from a standpoint of melting, than similar components made of electric-furnace mullite. However, when subjected to heat for any length of time, bonded alumina shrinks more (without appreciable deformation) than mullite.

For most pebble heater operations, mullite is chosen, although 300 to 400 F. below alumina on a refractory scale. Electric-furnace mullite has adequate strength plus the all-important volume stability at the temperature conditions and loads required.

Thermal Shock Can Hurt

Many chemical processes involve an instantaneous change in temperature, as in the production of acetylene and HCN. Others, such as carbon black reactions, involve a rapid water or steam quench.

Aside from process requirements, our present business tempo calls for rapid furnace cycles from hot-to-cold-to-hot without expensive shutdowns. Precautionary measures to minimize temperature fluctuations in the furnaces usually don't turn out too well economically.

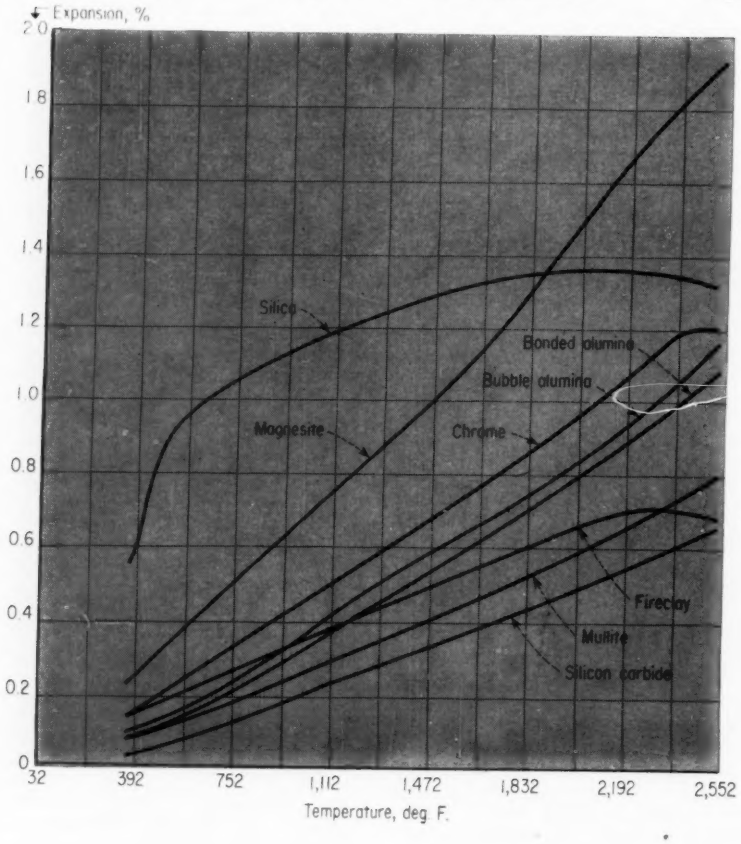
Under these conditions, the materials of construction are inevitably exposed to thermal shock. High thermal gradients develop in different areas of the lining or its parts, and on repeated cycles cracking and spalling* is likely to occur. This loss of fragments leads to a rapid deterioration.

Nonmetallic inorganic materials may spall from a variety of causes. Pressure sets up a stress that's known as mechanical spalling or pinching. Spalling can also occur from changes in the structure itself caused by pressure, vitrification or permeation of fluxes — structural spalling. Finally, spalling may be caused by rapid nonuniform heating. This condition produces the thermal shock that accounts for thermal spalling.

* Spalling is the breaking away of surface due to stresses during a temperature or physical change or because too great a thermal gradient exists.

Thermal Expansion of High-Temperature Materials

Fig. 5



Properties Influence Stresses

While thermal shock, furnace design, structural shape and operating conditions can be varied to affect performance, the physical properties of a material influence the development and distribution of thermal stresses. Tensile strength, thermal conductivity, modulus of elasticity and thermal expansion are the characteristics that determine how well a material will resist thermal shock. Although they're interrelated, these properties aren't independently variable.

Low thermal expansion is desirable since it prevents nonuniform expansion to a great degree. Thermal expansion of a number of high-temperature materials, over a wide range in temperature, is given in Fig. 5.

We've already discussed thermal conductivity and hot strength and you can now see how these characteristics function. Relative resistance to spalling of different types of refractory materials is a function of many factors. High thermal conductivity allows an entire body to be heated uniformly and quickly, while high moduli of rupture and elasticity indicate strength for resistance of spalling.

Silica Is a Problem

An inversion, with a large volume change, takes place between the different forms of silica at high temperatures. Thermal expansion problems presented by quartz, tridymite and crystobolite are shown in Fig. 6. Since most refractory nonmetallics contain some silica in the body or bond, this inversion must be coped with to minimize thermal spalling in most commercial high-temperature materials. Here are some rules-of-thumb so that you'll be able to handle the problem.

• Silica-containing materials, for use between 1,500 and 3,000 F., are most susceptible to spalling between room temperature and about 1,100 F. Between 500 and 1,100 F. you can safely use a heating or cooling rate of 300 F./hr. or less.

• In heating past 1,100 F., up to your working temperature (or in cooling down), a higher rate of about 400 F./hr. may be safely employed.

• Be very careful in heating and cooling in the low temperature ranges between 200 and 600 F. because crystobolite—the form silica is most likely to be present in—undergoes a reversible transformation at approximately 400 F. that's accompanied by a large change in volume. Therefore, if materials are carried through this critical range too rapidly, induced tensile stresses may cause cracking or spalling.

• From room temperature to about 500 F., a heating rate of 100 F./hr. or less is best. This isn't always possible but knowing these danger points is helpful.

How to Figure Heating Rates

One of the most ticklish problems in handling nonmetallic inorganic refractory materials arises when you have to figure just how to heat up a furnace. Problems with silica are outlined above. But now, let's take a look at the much more general case and its solution.

Given so much time to bring a furnace up to temperature—what would you do?

Probably, your normal tendency would be to divide the required temperature by the number of hours and arrive at a uniform heating rate. Actually, it would be much better if a very flat curve is used in the early part of the heating cycle followed up by rapid increases when higher temperatures are reached.

An early heating rate of 100 F./hr., followed by as much as 400 F./hr. is far better than an even rate of 150 to 250 F./hr. Temperature required is reached in the same time but the stresses within the furnace and components are kept to a minimum.

Some Materials Stand Up Well

Of all of the refractory materials available, carbon and graphite materials have the best over-all ther-

mal shock resistance. It's extremely difficult to devise tests that'll fracture these materials. Electrodes used in melting of fused-cast bodies and steel are often withdrawn, without cracking, from molten baths at temperatures over 4,000 F.

Although the mechanical properties of formed graphite vary considerably, coarse-grained grades have a strength of about 1,500 psi. in bending. Fine-grained grades may be as strong as 4,500 psi. Tensile strength is about ½ that of bend strength while crushing strength is twice bend strength.

Industry experience indicates that graphite tends to get stronger with increasing temperature. One variety of graphite, that breaks at 3,600 psi. at room temperature, increases its strength to 6,800 psi. at 4,800 F.

Recent developments aimed toward greater stabilization of zirconia components have improved their thermal shock resistance. Pure zirconia undergoes a crystalline phase change from monoclinic to a tetragonal around 1,800 F. This inversion is accompanied by a considerable decrease in volume. As the material is cooled down, there is a volume increase.

Lime and magnesia, as well as other materials, have been used to partially or completely stabilize zirconia in the cubic form.[10] However, some crystalline inversion is encouraged. The resulting material is composed of cubic crystals of zirconia, with a small but significant amount of monoclinic crystals. This combination tends to reduce the overall thermal expansion and give better thermal shock resistance.

Zirconia also has good load bearing capacity. Commercial mixtures made into 1-in. cubes didn't collapse until about 3,500 F. under load conditions of 40 psi. On these cubes, the first subsidence noted was at about 3,200 F.

Thermal expansion has a definite bearing on materials such as basic and fused-cast bodies. Although they're strong and have a moderate thermal conductivity, they also have such a high coefficient of expansion that they're more susceptible to thermal shock than silicon carbide or graphite.

Fused-cast materials have shown outstanding corrosion and erosion resistance in operations such as glass and sodium silicate production, electrolytic magnesium cells and phosphate rock furnaces. It's natural that chemical engineers should consider them for other work.

In most cases their intelligent use is severely limited by low resistance to thermal shock. Heavy insulation has been applied behind fused-cast pieces to minimize the thermal gradient. This approach has been successful in some rockwool reverberatory furnaces.

These Applications Have Worked

Examples of how thermal shock resistance has allowed different materials to be used in chemical process applications follow.

Spray Nozzles—Spray nozzles have to resist thermal shock and corrosion.

In the cooling of hot SO_3, a 15% water solution of this gas at 150 F. is sprayed into a chamber containing SO_3 gas at 1,700 to 1,800 F. Metal nozzles give less than a two-year life. Silicon carbide, on the other hand, lasts approximately five years.

Use of spray nozzles made of silicon-nitride-bonded silicon carbide in hydrofluosilicic acid work has proved the thermal shock resistance of this material.

Waste Disposal—In many chemical processes, toxic or other types of hard-to-dispose-of wastes are developed. Interesting progress is being made with activated sludges, but today, many wastes still have to be thoroughly destroyed in incinerators.

Often, the thermal shock is terrific because the waste material is charged into the incinerator as a liquid. Baffle walls increase turbulence in the furnace and also lengthen residence time of the materials being burned.

Silicon carbide and electric-furnace mullite have been used in baffle walls with considerable success. In one operation, silicon carbide stands up to a direct spray of a soot-laden slurry at 1,950 F.

Reforming—Reforming operations, that produce hydrocarbons such as HCN and acetylene, involve severe thermal shock. Electric-furnace mullite or silicon carbide is used to make Sachsse-process reactor linings because of this shock.

In HCN operations, where it's necessary to support a catalyst, silicon-nitride-bonded silicon carbide support beams have been satisfactorily used.

Chemical Resistance

Chemical action is one of the great factors leading to the destruc-

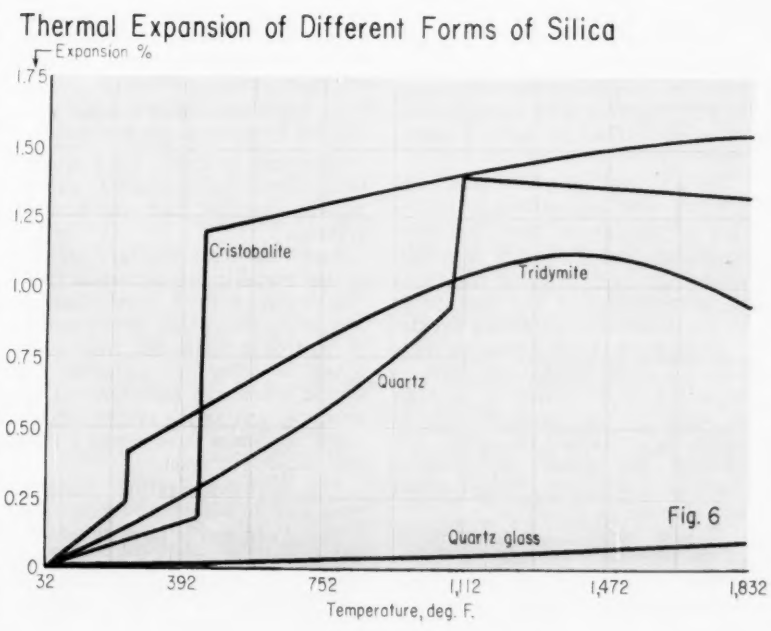


Fig. 6

tion of high-temperature materials. Attack may be by the material charged into a furnace, by slags or fluxing agents, by fuel ash, by furnace gases, by fumes or dust, or in some cases by other construction materials. Since all these possible conditions can exist, resistance to chemical attack is an important consideration.

Underlying facts here are that acids react with bases and vice versa and that reaction rates generally increase with temperature. Corollaries are: acid materials generally resist acid conditions and basic materials withstand basic conditions.

Of the materials we've covered: fireclay, silica and silicon carbide can be considered acid in nature; alumina and mullite range from acid to neutral; chrome, magnesite, periclase and the like are basic.

Any construction material that works in a chemical process indicates it has some chemical stability and resistance to reaction. Often, a material that performs satisfactorily can be replaced by another material with a similar or higher degree of chemical stability plus an additional useful property such as abrasion resistance, better insulation or thermal shock resistance.

Some Gases Are Reactive

How the high-temperature materials of construction hold up when exposed to various gases over a range in temperature is shown in the large chart.

Oxidizing Atmosphere—Most oxide base and fireclay materials are inert to oxidation whether caused by CO, CO_2, H_2O or O_2 (even CO can cause oxidation in certain materials).

Carbon and graphite materials are the most susceptible to oxidation of the group that has been discussed. Manufacturers definitely discourage use of these materials at temperatures of any magnitude in the presence of oxidizing agents.

Some work is being done on coatings for graphite that are inert to oxidation at temperatures as high as 4,500 F. Increases of 300 to 400% in oxidation resistance are claimed for some experimental coatings of alumina, silicon carbide and zirconia on graphite.[8]

Silicon carbide, the most stable of the refractory carbides, will also oxidize under certain conditions. This can be visualized by looking at the production of silicon carbide:

$$SiO_2 + 3C = SiC + 2CO$$

This reaction is reversible. Silicon carbide reacts with carbon monoxide (or carbon dioxide, water vapor or oxygen) to form a layer of silica on its surface.

Below 1,500 F. the reaction rate is slow. Between 1,500 and 2,100 F., silicon carbide deteriorates with the greatest danger at 1,800 F. Above 2,200 F., there's little oxidation because the silica formed, slightly contaminated by iron oxide and alumina, sinters and provides a degree of protection for the silicon carbide. Above 2,800 F., the coating becomes more fluid and leaves the silicon carbide exposed to oxidizing gases.

Under some conditions, carbon from the breakdown of carbon monoxide into carbon and carbon dioxide can be deposited within reactor linings. This carbon builds up around iron impurities in the refractory materials and sets up severe disrupting forces. The trick here is to select and work with low iron content materials or materials where the iron impurities have been tied up in chemical complexes.

Hydrogen Atmosphere—In molecular form hydrogen won't cause damage to the materials we've discussed. Above 2,500 F., increasing up to 2,900 to 3,000 F., molecular hydrogen breaks down to nascent or atomic hydrogen. In this form, hydrogen will attack silica or iron causing reactions that destroy silica-containing materials. The reaction is usually written:

$$8H^+ + SiO_2 \rightarrow 2H_2O + SiH_4$$
$$\text{or } 4H^+ + SiO_2 \rightarrow 2H_2O + Si$$

Hydrogen in atomic form can attack silicon carbide, silica, zircon, mullite, fireclay and clay-bonded alumina.

Reactions with iron are similar in that metallic iron is formed from iron oxide with a corresponding rise in the dew point. This reaction of hydrogen with the iron oxide found in refractory materials has caused trouble in metallurgical operations such as the bright annealing of stainless steel where a fixed dew point is a must.

The high-temperature material most used to withstand attack from atomic hydrogen is pure alumina—either bonded crystals or bubbles. When hydrogen is present, commercial varieties of bonded alumina (90-92% Al_2O_3, 5-8% SiO_2) aren't suitable for temperatures above 2,700 F. These materials are available, however, in forms that contain 98 to 99%, or more, bonded alumina. Other materials that can withstand atomic hydrogen are magnesia and zirconia.

Sulfur Atmosphere—Sulfur reacts with most high-temperature materials above 1,600 F.

However, elemental sulfur gases and SO_2 aren't detrimental to silicon carbide at temperatures up to 1,600 F. It's extensively used in sulfur burners and in lining pipe to and from sulfur trioxide converters. Graphite is satisfactorily used to handle SO_2 in gas compression equipment.

Chlorine Atmosphere — These gases attack silica-containing materials above 1,200 F.—end product is silicon tetrachloride.

Graphite, because it's so resistant to chlorine gas, is used to line furnaces for the continuous chlorination of metallic ores at 2,500 to 3,000 F.

Tackling Gaseous Attack

There are many direct applications of high-temperature materials to the conditions mentioned above.

Pebble heaters are used in a variety of oxidizing conditions. Although silicon carbide is adequate for this use so far as strength and volume stability are concerned, oxidizing conditions rules it out as a construction material. Electric-furnace mullite is much better.

On the other hand, even though chlorine attacks silicon carbide, the attack isn't a major factor in HCl burners. Chlorine has a greater affinity for the hydrogen present than for the materials of construction.

In Hasche reformers, used in the Wulff process, temperatures are high enough for atomic hydrogen to be present. Therefore, silicon carbide isn't used, even though it has the advantages of high emissivity and thermal conductivity. Special arrangements of alumina checkers make the most of alumina's high density and specific heat.

These examples show a few situations where atmospheric conditions can dictate your choice of a material that might have been made on the basis of a more obvious physical characteristic such as

thermal conductivity, impact resistance or permeability.

Acid Resistance Is Limited

Since acidic materials resist acids and basic materials resist bases, we can eliminate chrome, magnesia, periclase and other basic products from a discussion of acid resistance. Materials such as bonded alumina are neutral to acids but depend on the amount of silica in the bond. Actually, fireclay, carbon and silicon carbide are the best approaches to this problem.

Acidbrick—Special varieties of fireclay, where the silica content is 10% greater than in commercial firebrick, are called acidbrick. Fireclay acidproof materials have low permeability and are highly resistant to corrosion. All other things being equal, this is the best choice for acid service, the exception being hydrofluoric acid, the only acid that attacks silica.

Acidbrick's main draw-back is low thermal shock resistance—even when you compare it with commercial fireclay. Ordinarily, thermal shock conditions aren't severe enough to justify special materials, but there are some cases where they're necessary. Spray nozzles that resist a combination of thermal shock and corrosion in cooling hot SO_2 gas in a sulfuric acid decomposer are a prime example.

Silicon Carbide—Resistance to both HCl and sulfuric acid is a determining factor in using silicon carbide for the domes of Mannheim furnaces and Monsanto-Ross-Wilde sludge decomposers.

Perchloroethylene units require resistance to chlorine, HCl and chlorinated hydrocarbons at 1,100 F. Silicon carbide has performed under these conditions for more than 10 years without replacement.

Carbon and Graphite—These materials have stood up well in acid service for many years. They are extensively used in heat exchangers, hydrogen-chlorine burners, submerged combustion heaters and coolers.

Graphite, a unique material for this use, forms a submerged combustion tube in the evaporation of ferric and ferrous chloride, as well as hydrochloric acid; it works well in heater units of pickle-liquor tanks; it holds up against the corrosive conditions involved in uranium recovery from wet process phosphoric acid;[11] and is used as the hearth in tricalcium phosphate furnaces.[2]

Slags Are Very Corrosive

Most slags are economically handled by fireclay, silica or the basic materials. These constitute the largest portion of high-temperature materials purchased in the process industries. Selection is based on their moderate refractoriness, relatively low conductivity, general chemical inertness and low cost.

Some of the more corrosive conditions met in the chemical industry are handled by fused-cast bodies. Very common use is made in furnaces melting glass, sodium silicate and phosphate rock. In the synthesis of coal with steam and oxygen, the highly corrosive slags developed are adequately handled with these same type fused-cast bodies.

In conditions that require extreme chemical stability, stabilized zirconia sometimes fits in. This is the only commercial material that doesn't react with barium and strontium titanates. Unfortunately, zirconia does react with basic steel slags and is completely exempt from this service. Here, pure magnesia seems to fit the bill.

Molten Metals Can Be Contained

When oxidation isn't a problem, carbon seems to be the top-notch material for containing molten metals. Since carbon and graphite aren't wet by most metals, they work out extremely well in neutral or reducing atmospheres—copper, brass, magnesium, aluminum, silicon and high and low carbon steels—just to mention a few of the metals they can handle. On the other hand, some metals don't work out too well. Titanium, zirconium, vanadium and molybdenum form carbides when in contact with graphite.[9]

Nonferrous metals, such as copper, brass, aluminum, zinc, lead and cadmium, don't attack silicon carbide. Silicon-nitride-bonded silicon carbide is inert to molten aluminum and, therefore, fits into a variety of uses for this work.

In electrolytic cells, where magnesium metal is produced by the Dow process, fused-cast alumina is satisfactory. In the Pidgeon vacuum process, both silicon-nitride-bonded silicon carbide and bonded alumina are successful.

Remember Permeability

As an overall group, nonmetallic inorganic materials are porous. After manufacture, they contain definite interstices between the crystal or grog particles. Porosity is the % volume pores in relation to the total volume of a piece. Permeability, on the other hand, is the rate of flow of a gas through this piece. Size and number of connected pores or channels that are continuous govern the permeability. Porosity takes into account all the voids, whether open or closed.

Permeability is given in the large chart in terms of cu. ft. of cold air that will pass per hr. through a 1-sq. ft. panel, 1-in. thick at a pressure drop of 1 in. of water.

You have to be careful about this difference between porosity and permeability. Materials with high porosity don't always have high permeability as is shown in the following example: Fireclays generally have a porosity anywhere from 18 to 25% and a permeability from 3 to 72 cu. ft./(sq. ft., hr.,/ in. thick). But, materials made from certain New Jersey fireclays have a high porosity of 27% while the permeability is only 6.

Fused-cast materials are extremely dense and have a minimum of inter-connected pores. They're almost completely impermeable to liquids and gases. Their structure depends on crystal-to-crystal junctions and there's little or no bond or change in structure from their poured shape to the used shape.

Silicon carbide also has the great attribute of low permeability. It's capable of limiting the passage of cold air to 1 or 2 cu. ft./hr. This is most important in the application of the material to externally-heated tubes carrying hydrocarbon gases for cracking, or reforming. Leakage through the tube minimizes the effectiveness of any reaction being carried out and, worse still, it could set up dangerous explosive conditions.

Silicon carbide can withstand a differential internal pressure of 5 to 10 psi. without any appreciable leakage. It's possible to use techniques such as butt joints, tongue and groove joints, tapered lap joints or ball and socket joints to minimize gas leakage at the junctions of these tubes.

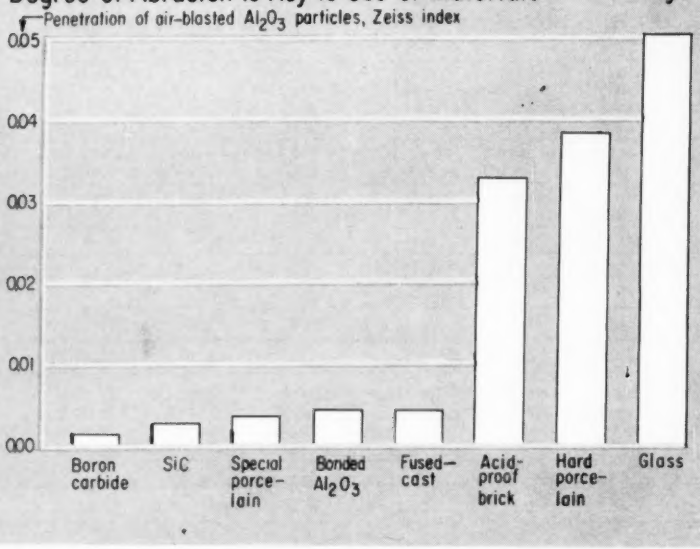
Acidproof brick is also a material of very low permeability and

Use This Table to Help Select High-Temperature Materials of Construction

			Graphite	Carbon	Magnesia	Zircon $ZrO_2 \cdot SiO_2$	Bonded 99% Al_2O_3	Bubble Alumina	Fused Cast
Melting point, deg. F.			sublimes at 6,330	converts at 3,992	5,072	4,390	3,660	3,380–3,550	3,640
Bulk density, lb./cu. ft.			137		175	205	165–175	80–85	175–219
Thermal conductivity, Btu./(hr., sq. ft., deg. F./in.)			220 at 2,000 F.	23 at 2,732 F.	18 at 2,000 F.	22 at 2,192 F.	24 at 2,200 F.	7.7 at 2,400 F.	24–31 at 2,200 F.
Coefficient of thermal expansion, in./(in., deg. C.)			7.8×10^{-6} 25–40 C.	$1.5–5.5 \times 10^{-6}$ 25–500 C.	13.5×10^{-6} 25–800 C.	5.5×10^{-6} 20–1,200 C.	7.4×10^{-6} 25–1,400 C.	8.6×10^{-6} 25–1,400 C.	$4.9–8.6 \times 10^{-6}$ 25–1,400 C.
Mean specific heat, Btu./(lb., deg. F.)			0.390 56–1,450 F.	0.387 56–1,450 F.	0.283 86–2,012 F.	0.15 75–210 F.	0.33 32–2,552 F.	0.32 32–2,552 F.	0.28–0.32 32–2,552 F.
Emissivity at 1,500 F.			0.97	0.97	0.51	0.53	0.47	0.55	0.51
Permeability, cu. ft./(hr., sq. ft./in.)					3–61	10–78	3–51	>100	0.5–2
Apparent porosity, %					19	11–26	22	54–67	2.5–7.5
Moh's hardness			1–2	1–2	6.0	7.5	9.0	2.5–5.0	9.2
Modulus of rupture, psi.						157 at 2,732 F.	200–900 at 2,462 F.	63 at 2,462 F.	703–>1,500 at 2,462 F.
Electrical resistivity, ohm-cm.			0.00076 1,500 F.	0.0039 1,832 F.	1,500 F.–4×10^6 2,500 F.–10,500	High	1.2×10^{13}–1×10^6 580–2,000 F.		175–55 1,832–2,552 F.
Wt., lb./9-in. brick					10	11–12.5	9.7–10.4	4.8	10–13
Thermal shock resistance			excellent	excellent	poor	good <3,150 F.	fair	fair	poor
Abrasion resistance			poor	poor	poor	fair	good	poor	excellent
Use limit, deg. F.			4,000 red. atm.		4,172–oxid. 3,092–red.	3,100	3,300	2,800–3,200	3,300
Cost, dollars '9-in. brick					2.81	1.39	3.12	1.52–3.34	4.65–6.30
Chemical resistance	**Slags**	**Acid**	good	good	poor	good	good	good	excellent
		Basic	good	good	good	poor	good	good	good
	Molten metals	Al	excellent	excellent	fair	good	good	good	good
		Fe	excellent	excellent	good	good	good	good	good
		Na	excellent	excellent	fair	poor	poor	poor	fair
		Pb	excellent	excellent	good	good	good	good	good
		Zn	excellent	excellent	good	good	good	good	good
		Mg	excellent	excellent	poor	fair	good	fair	excellent
	Gases	CO_2	B<1,652 F. E>1,652 F.	B<1,382 F. E>1,382 F.	A	A	A	A	A
		CO			A	A	A	A	A
		H_2O, steam	B<1,292 F. E>1,292 F.	B<1,202 F. E>1,202 F.	D hydroscopic	A	A	A	A
		O_2 air	B<932 F. E>932 F.	B<707 F. E>707 F.	B<4,172 F.	A	A	A	A
		F_2	A	A	D	D-E	B<1,800 F. D>1,800 F.	D-E	D
		Cl_2	A	A	D	B-D	A	B-D	A-D
		H_2	A	A	B<3,092 F. D>3,092 F.	E>3,272 F.	A	A	A
		HCl	A	A	D	A	A	A	A
		NH_3	A	A	A	A	A	A	A
		SO_2	A	A	B–C	A	A	A	A
		S_2	A	A	B	B–D	A	A	A–C
	Heated acids	HNO_3	A	A	D	A	A	A	A
		H_2SO_4	A	A	D	A	A	B	A
		HCl	A	A	D	A	A	B	A
		HF	A	A	D	B–C	A–C	C	A–C
		H_3PO_4	A	A	D	A–B	A	B	A
	Hydrocarbons		A	A	B<3,092 F. D>3,092 F	A–D	A	A	A

A = No reaction, material entirely suitable for service indicated.
B = Slight reaction, material suitable for service indicated.
C = Reaction, material suitable under certain conditions.
D = Reaction, material not acceptable unless tested under operating conditions.
E = Rapid reaction, material not acceptable.

Zirconia Stabilized	SiC	Silicon-Nitride-Bonded SiC	Magnesite	Chrome $FeO \cdot Cr_2O_3$	Fosterite $MgO \cdot SiO_2$	Synthetic Mullite $3Al_2O_3 \cdot 2SiO_2$	Converted Mullite $Al_2O_3 \cdot SiO_2$	Silica	Superduty Fireclay
4,710	diss. at 4,082	diss. at 3,542	5,070	3,540–3,990	3,461	3,317	3,250	3,140	3,120
275	153–162	168–178	160–175	170–190	150–155	147–156	140–150	100–110	134–141
7 at 2,400 F.	109 at 2,200 F.	113.5 at 2,200 F.	20 at 2,200 F.	12 at 2,400 F.	10.3 at 2,200 F.	15 at 2,200 F.	14 at 2,400 F.	14.3 at 2,200 F.	10 at 2,192 F.
5.5×10^{-6} 20–1,200 C.	4.4×10^{-6} 25–1,400 C.	4.4×10^{-6} 25–1,400 C.	14.7×10^{-6} 0–1,400 C.	10.4×10^{-6} 0–1,540 C.	11.0×10^{-6} 0–1,425 C.	4.6×10^{-6} 25–1,400 C.	5.3×10^{-6} 0–1,700 C.	8.6×10^{-6} 25–1,500 C.	6.0×10^{-6} 25–1,000 C.
0.20 0–1,200 F.	0.288 0–2,552 F.	0.288 0–2,500 F.	0.27 60–1,200 F.	0.21 60–1,200 F.	0.25 0–1,200 F.	0.23 32–2,552 F.	0.23 32–2,552 F.	0.28 32–2,600 F.	0.27 32–2,600 F.
0.53	0.93	0.93	0.48	0.97	0.95	0.51	0.51	0.76	0.54
4–32	1–6	1–4	7–20	6–14	10–25	3–48	3–40	41–54	3–72
19–50	13	8	20–28	20–28	24–27	20–27	15–22	18–43	12–16
6.5–7.5	9.6	9.6	5.0–5.5	5.5	7.5	6–7	6–6.5	7.0	6.0
100–980 at 2,732 F.	800–3,125 at 2,462 F.	5,640 at 2,462 F.	750–3,000 at 68 F.	25–125 at 2,462 F.	450–800 at 68 F.	100–575 at 2,462 F.	50–375 at 2,462 F.	20–75 at 2,462 F.	25–375 at 2,462 F.
12.90–1.6 2,300–3,090 F.	7,420–745 1,832–2,732 F.			650–40 1,500–2,500 F.		10^{6}–10^{3} 1,500–2,500 F.	10^{4}–10^{3} 1,500–2,500 F.	10^{6}–10^{7} 1,000–1,400 F.	10^{6}–10^{3} 1,500–2,500 F.
14–15	9–9.5	9.9–10.4	10.0–11.5	11.0–12.0	9.1–9.8	8.6–9.1	8.5	6.0–6.7	7.5–9.0
fair	excellent	excellent	fair	fair	fair	good	good	excellent	fair
fair	excellent	excellent	fair	fair	good	fair	fair	fair	fair
4,600	2,800–3,000	2,900–3,000	2,900–3,200	2,800–3,200	3,000	2,900–3,100	2,800–3,000	3,100	2,500–2,800
10.80	2.14	4.28	0.68–0.70	0.55–0.58	0.57–0.60	0.89–1.76	0.68	0.15–0.16	0.18–0.24
good	good	excellent	poor	poor	poor	good	good	good	good
poor	fair	fair	good	fair	fair	good	fair	poor	poor
good	good	excellent	fair	fair	fair	fair	fair	poor	fair
good	poor	poor	good	good	good	good	good	good	good
poor	poor	poor	poor	poor	poor	poor	poor	poor	poor
good	excellent, red. atm.		good	good	good	good	good	fair	fair
good	excellent	excellent	fair	fair	fair	good	good	good	good
fair	good	good	fair	fair	fair	fair	fair	poor	poor
A	B<1,500 F. B>2,100 F.	B<1,500 F. B>2,100 F.	A	A	A	A	A	A	A
A	B<1,500 F. B>2,100 F.	B<1,500 F. B>2,100 F.	B–C	B–C	A	A	B–C	A	C
B–C	B<1,500 F. B>2,100 F.	B<1,500 F. B>2,100 F.	A	A	A	A	A	A	A
A	B>1,500 F. B<2,100 F.	B<1,500 F. B>2,100 F.	A	A	A	A	A	A	A
D	D	C–D	E	E	E	E	E	E	E
B	A<1,300 F. D>1,300 F.	A<1,300 F. D>1,300 F.	D	C–D	Chlorine attacks silicates above 1,300 F. C–D	B–D	B–E	C–E	C–E
E>3,900 F.	A<2,600 F. D>2,600 F.	A<2,600 F. D>2,600 F.			Nascent or atomic hydrogen attacks silica and iron.				
A	A	A	D	C–D	C–D	A	A	A	A
E>3,990 F.	A	A	A	A	A	A–C	A–C	A–C	A–C
A	A	A	C–D	C–D	C–D	A	A–C	B–C	B–C
A–B	A<2,200 F. D>2,200 F.	A–C	B–D	B–C	B–C	Sulfur in strong concentrations reacts with silica above 1,700 F. B	A–C	B–C	B–C
A	A	A	D	B–C	B–D	A	A	A–C	A–C
A	A	A	D	B–D	B–D	A	A	A–C	A–C
A	A	A	D	B–D	B–D	A	A	A–C	A–C
B–C	B–D	C–D	D	B–E	B–E	C–E	C–E	E	E
A	A–B	A	D	B–D	B–E	A–B	A–B	A–C	A–C
A	A–D	A–C	B–C	B–C	B–C	A–D	A–D	B–D	B–D



is successful in containing corrosive acids and gases. Unless there are conditions of thermal shock, abrasion or a need for high thermal conductivity, the acidproof materials are economically most satisfactory.

Other materials on the chart are in the middle range of permeability and don't merit any particular comment. Of course, there are materials such as insulating firebrick and bubble alumina that have permeability values way above any conventional chart.

Abrasion Resistance

Abrasive conditions appear as a common denominator in many process installations. Some of the areas you're bound to run into abrasion are: dust collectors, transfer pipe lines, gas scrubbers, hydrocyclones, rabble blades and actual process equipment parts.

In order to have some measure of the hardness and abrasion resistance of the nonmetallic inorganics, the wearing effect (penetration) of air-blasted, 100-mesh alumina particles was determined. You'll notice from the results in Fig. 7 that the same materials used in grinding wheels to abrade—silicon carbide and alumina—resist abrasion particularly well.

Bethlehem Steel made similar investigations of the abrasion resistance of a wide range of fireclay, silicon carbide, bonded alumina and fused-cast materials.[4] Their results followed pretty much to form with silicon carbide and the fused-cast materials again giving the best performances.

Understand Types of Abrasion

In selecting abrasion-resistant materials, a major point is an understanding of the two basic types of abrasion: an impingement by fine solids that are suspended in either air, gas or liquid, and direct abrasion by a mass of dry or wet solids moving across or at a surface.[18]

Degree of abrasion depends on variables such as size, hardness, shape, weight, concentration of abrasive particles, velocity and direction of impact, operating temperature and corrosive nature of the abrading material and atmosphere.

In most high-velocity impingement work, failure is primarily erosion, and bonded materials generally are your best solution.

When heavy particles directly fall or glance on a surface a minute progressive bond fracture of ceramically-bonded materials can take place. In this case, the refractory material is mechanically lifted away since the bond that holds it together is destroyed. Similar action on monolithic materials results in chipping and gouging.

Abrasion of this type is best met with fused-cast materials rather than bonded alumina or silicon carbide. Fused-cast bodies don't depend on a bond as the ceramic-fired materials do.

Extreme toughness and hardness of a material is definitely an asset when both abrasion and corrosion are combined. If hardness prevents a breakdown by abrasion, chemical attack is retarded. However, if chemical attack destroys the bond, nothing can prevent the granular segments from being washed away. When the bond is susceptible to attack, fused-cast bodies that depend on a crystal-to-crystal interlock are the best choice.

Abrasion Can Be Controlled

Resistance to abrasion would be better used as a criteria for selection if more were known of the materials of construction. Chutes, hoppers and pneumatic conveyor lines handling limestone, sand, alumina, coke or iron ore—to name a few abrasives—are successfully built of paving brick, silicon carbide and fused-cast materials.

Catalytic Crackers—You should immediately recognize the need for using one of the hard nonmetallic inorganic materials in any part of a piece of equipment, such as this, where a pressure drop or change in direction of the flow of catalyst causes abrasion.

Silicon carbide is used in exhaust stacks, valve components and deflector wear plates.

Spray nozzles are found in the exhaust lines where high-pressure air and steam retard and control after-burning. Corrosiveness of the steam, as well as the cutting action of catalyst entrained in eddy currents around the nozzles, prevent the use of alloy parts. Silicon-nitride-bonded silicon carbide has worked out well.[28]

Pebble Heaters—There are severe abrasive conditions in this type of equipment. Silicon carbide isn't successful because the pebbles break and destroy the bond holding the silicon carbide crystals together. Similar failures occur in catalytic cracking units such as TCC (Thermofor Catalytic Cracking) where a bead or cylindrical pellet is used instead of the fluidized finely-divided catalyst.

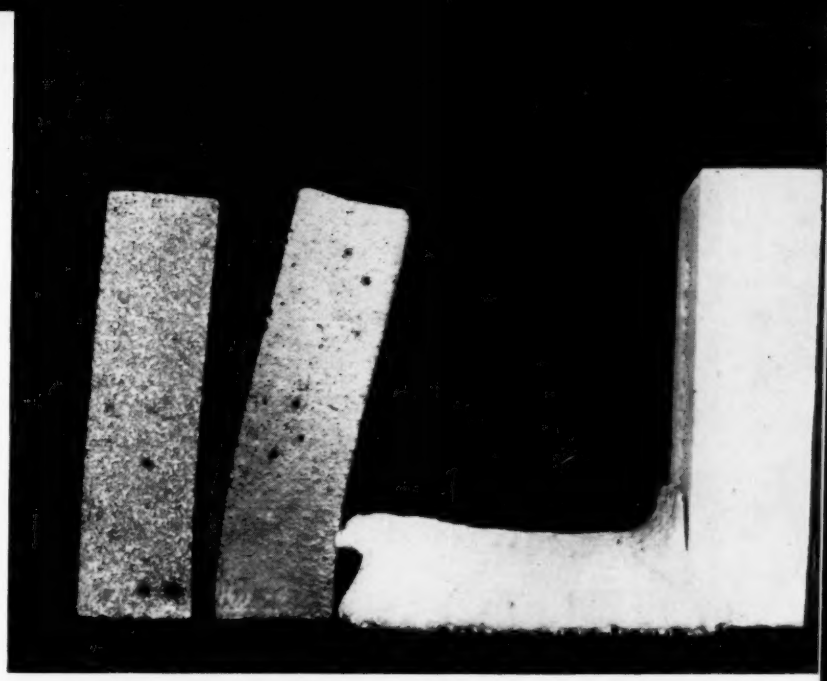
Acid Slurry Pumps — Silicon-nitride-bonded silicon carbide is used as a suction cover for centrifugal pumps. Where abrasive materials are handled, bonded alumina is very satisfactory.

Grinding Mills—For grinding pigments and chemicals, particularly such abrasive ones as enamel frits, mills are lined with fused-

cast alumina to withstand the abrasion.

Venturi Dust-Catchers—Silicon-nitride-bonded silicon carbide, silicon carbide and fused-cast materials are used for the linings.

Rabble Teeth—Silicon carbide is used for rabble teeth and blades on mixing equipment. An outstanding example is in multiple-hearth furnaces for treating ferric wastes from tin smelting operations. End products are ferric chloride and a weak acid. Special-service alloys were replaced by silicon carbide rabble teeth. Cost of the silicon carbide rabble teeth is less than that of alloys and, most important, up to 15 times as much life is obtained.



Refractoriness Is Last

Resistance to heat should be the last product characteristic you consider in selecting a 1,500 to 3,500 F. material for application in a chemical engineering process. By definition, a refractory material is distinguished from other materials by its ability to resist heat. In too many cases, these materials are chosen only on the basis of temperature and without enough consideration to the characteristics and conditions we've outlined.

P.C.E. Causes Difficulty

One of the main reasons there's a great deal of difficulty with the concept of refractoriness is the ceramic industry's use of P.C.E. (pyrometric cone equivalent). What a P.C.E. value means is: if a material is ground up, made into a cone and placed in a kiln, its tip will bend over and touch the supporting plaque at the same time as a standard cone of that number. You always have to remember that pyrometric cones are used in the ceramic industry to measure the effect of both time and temperature and not temperature alone.

From a P.C.E. standpoint, almost all the refractory materials we've considered can be safely used above 3,000 F. Electric furnace materials have pyrometric cone equivalents from 37 to 40, high-duty firebrick from 31 to 33 and super-duty firebrick from 33 to 34. If you look at these materials just from their P.C.E. values, they don't seem very different. Be careful, it's easy to be misled. As an example, four bricks, all having a P.C.E. above 30 (3,002 F.) were held at that temperature for five hours. They slumped, all differently, as shown in the photograph.

Don't let this surprise you. Remember, a cone made of a material with a P.C.E. of 30 will bend over and touch its tip at that temperature in the same time a standard cone will. These P.C.E. values are standards of thermal behavior to determine the refractoriness of materials when compared with a standard cone. They won't help you much when you want to know if the material can carry a load at high temperatures. Experience tells us that safe working temperatures are often well below the P.C.E. value.

Some materials—fireclay, insulating firebrick and high-alumina fireclay—begin to soften well below their indicated P.C.E. values. Because of exceptional purity, dense structure and emphasis on development of crystalline structure, electric-furnace materials such as alumina, mullite, silicon carbide and fused-cast bodies, give service at temperatures much closer to their P.C.E. values.

Crystal Size Plays a Major Role

Some high-temperature materials will change their crystalline structures after prolonged heating. Most susceptible to this change are materials with fine-grained or microscopic-sized crystals. These crystals enlarge when you heat them with an overall weakening and opening up of the structure. Result—penetration by fluxes and gases that cause internal attack. Originally impermeable bodies, can sometimes become quite open with grains changing from microscopic to easily visible sizes.

Mullite particularly shows this type of crystalline growth. Mullite crystals are often so small they have to be identified by X-ray diffraction tests. This is gotten around by a little change in the manufacturing process.

Electric furnaces manufacture mullite by charging balanced amounts of Al_2O_3 and SiO_2 into the furnace, melting the batch and then letting it cool down slowly to form large mullite crystals ($3Al_2O_3 \cdot 2SiO_2$). If it's possible to work with these large prefused crystals, chemical and structural stability during service is greatly improved.

High-temperature materials are often made with prefused material having well advanced crystal growth. Fusion of the grog slows crystalline growth when the body is exposed to heat for extended periods of time.

Some Materials Have Shortcomings

One of the more promising materials, zirconia, has a melting point of 4,900 F. and a recommended maximum use point of 4,600 F.[22] Pure zirconia, however, has the drawback of an uneven expansion and contraction that results in growth unless the material is fully stabilized.

It's difficult to get any degree of permanent stabilization so that even stabilized zirconia has its

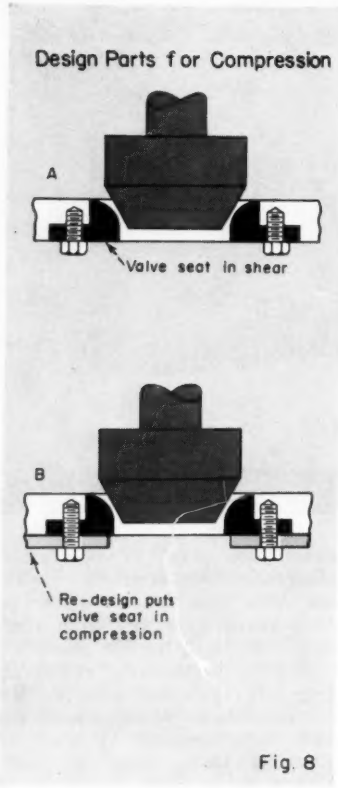


Fig. 8

shortcomings. Nevertheless, this this material has been successfully used in the Eastman acetylene-ethylene process, for periods of 100 days at temperatures up to 4,532 F., without any significant deterioration.[1]

Although they're extremely refractory, carbon and graphite are susceptible to oxidation. Still, in all three types of electric furnaces —resistance, inductance and arc— graphite is an accepted material of construction.

Magnesia, another important material, has a very high melting point and should find increasing use in the process industries. Best known of the commercial applications of this material in the chemical industry was as a furnace lining in the Wisconsin process for the thermal fixation of atmospheric nitrogen.[14]

Rules for Shape Design

All the materials we've discussed are available as standard brick. In large process units, such as pebble heaters, Mannheim furnaces, air heaters and multiple-hearth furnaces, the primary unit of construction is a 9-in. brick or equivalent. These materials are also supplied as special shapes which make up the bulk of sales for the chemical industry. Work is also done with castables and materials that are rammed or poured into shape to achieve their final form.

There are surprisingly few limitations on the complexity of a shape that can be made. As a general rule, sizes up to 50-in. in one direction can be made, and it's possible to cut thickness down to ½ in., depending on the other dimensions. Most manufacturing specifications assure good dimensional accuracy.

Shape and size of a piece are extremely important. Many configurations are possible, but not practical. Keep these points in mind:

- Extremes in thickness should be avoided, as well as any sharp changes in sections.
- Walls less than ¼ in. thick are difficult to produce and are quite fragile.
- Ordinarily, sections over 1½ to 3-in. thick are equally undesirable since resistance to thermal shock is impaired. With a body that has a relatively high coefficient of expansion and low thermal conductivity, any increase in thickness sets up greater stresses.
- Very small parts can cause manufacturing difficulties that may eliminate some of the cost advantages that are possible over metal.
- With a long, thin shape, there is a tendency to warp in firing.

Bear in mind that a uniform cross section with a minimum of projections is desirable. Abrupt cross-sectional changes can't always be avoided. If such a problem is faced, try to design the part into separate pieces.

- If a refractory part is subjected to both cold and hot, keep the length of the material to a minimum. It's even desirable to use two shapes, one for the "cold" portion of the service and the other for the "hot" portion.

Unlike metals, the nonmetallic inorganic materials don't have a stress-strain ratio or yield point. The stronger the material is, the more brittle it becomes, and the more susceptible to any bending moment. Fireclay materials, however, do have some yield. This occurs when the materials are exposed to temperatures high enough to allow some thermoplastic deformation. Practically all of the nonmetallic inorganic materials break before they have any flexure.

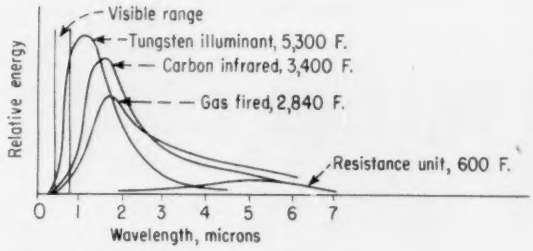
Some of the materials, particularly high strength bodies such as bonded alumina, fused-cast bodies and silicon-nitride-bonded silicon carbide, have very high compressive strengths. Most of these, however, have low tensile strength. Simple changes in design, such as illustrated in the valve seat construction in Fig. 8 can take advantage of the superior compressive properties. Design A puts the seat in shear, while Design B puts the material under compression.

Consider another example. On externally threaded silicon-nitride-bonded silicon carbide parts that fit into steel parts, the metal can expand without damage to the nonmetallic. Internal threads, on the other hand, place the nonmetallic under high tensile stresses due to the higher expansion of the metal coupling.

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No matter which radiant heat source you choose . . .



The key to best design is still . . .

1. **What wavelength energy is emitted? (Rather than, at what temperature.)**
2. **How much radiation is actually absorbed?**
3. **What does it cost?**

How to Design for Radiant Heating—II

LLOYD M. POLENTZ, Engineering Consultant, Whittier, Calif.*

LAST issue we discussed the theory of radiant and infrared heating. Now let's apply that theory to the design or selection of some radiant heating equipment to perform a given job.

First we'll want to examine the types of radiant heating equipment that are commercially available and compare some of their features. Most logical way to divide the equipment into groups is either by operating temperature or by the wavelength of the energy emitted by the source.

The type of energy (gas, electric or steam) used to operate the equipment is really of little importance from the standpoint of radiant-heating design since the only two points of concern are:

- Most important, the wavelength of the emitted energy; which is a function of the temperature.
- The coefficient of emissivity of the source.

What Can You Buy?

Shortest wavelengths and highest source-temperatures of commercially available radiant heating equipment are obtained with industrial infrared lamps. The bulk of the emitted energy lies in the range of 0.5- to 2.0-microns wavelength (see chart above).

Next shortest wavelength is obtained from the carbon filament infrared radiators operating at 3,400 F. Then we have the gas-fired ceramic radiators available either as a series of small conically shaped burner-radiators, or as trough-shaped burner-radiators of adjustable length. These use natural gas, manufactured gas or LPG as fuel and use the heat of combustion to raise the ceramic cups (or troughs) to an incandescent temperature. Then the ceramic radiates.

Heating efficiency of these units is reduced by the large amount of heat which is lost with the products of combustion.

The next series of commercial radiant heaters is made up of electrical resistance units of one type or another ranging in temperature

* To meet your author, see *Chem. Eng.*, April 7, 1958, p. 182.

Coefficients of Emissivity for a Few Common Materials

Material	Temperature, deg. F.	Coefficient
Aluminum, highly polished	440–1,070	0.039–0.057
Copper, calorized	390–1,110	0.18 –0.19
Steel, calorized	390–1,110	0.52 –0.57
Chromium	100–1,000	0.08 –0.26
Gold, pure, highly polished	440–1,160	0.018–0.035
Iron, polished	800–1,180	0.144–0.377
Rolled sheet steel	70	0.657
Oxidized iron	212	0.736
Steel, oxidized at 1,100 F	390–1,110	0.79
Iron oxide surface	930–2,190	0.85 –0.89
Rough steel plate	100-700	0.94 –0.97
Asbestos, board	74	0.96
Asbestos, paper	100-700	0.93 –0.95
Refractories (avg. of 40)	1,110–1,830	0.75 –0.90
Quartz, rough fused	70	0.932
Glazed porcelain	72	0.924
Water	32–212	0.95 –0.963
Glass, smooth	72	0.937

from 1,400 F. to 600 F., and lower if desired. At the upper end of this range (1,400 F.) are the tubular heaters, usually equipped with reflectors. Next, up to 1,200 F., are the familiar strip heaters which are usually used for contact heaters, but which operate quite satisfactory as radiant heaters.

In the lower-temperature range of 600 to 700 F. are the glass heaters which are of two general types: plate glass with an electrical resistance unit fused to the back face; or the type of heater which can be designed and fabricated quite satisfactorily from glass-wrapped resistance wire.

Basically, It's This

Basically, what all of these are—and what any radiant heater is—is a hot source to radiate energy backed up by insulation to make sure that energy does not dissipate out the back, where it would serve no useful purpose.

In the higher-temperature units (infrared lamps and high-temperature tubular heaters) it's common practice to back the units up with reflectors so that the energy which radiates out the back side can also be directed toward the work. With the lower-temperature units, the bulk of the area is ordinarily occupied with heating units and there is very little space available for the energy from the back of the unit to be reflected onto the material being heated.

Therefore, many of these units are not equipped with reflectors; they are merely insulated on the back side with any good insulating material.

Consider the Emissivity

It might be in order to note here the effect of the coefficient of emissivity of the radiant unit. There have been special designs offered for sale at rather high prices with the principal selling point being a high coefficient of emissivity.

As we mentioned in the first part of this article (*Chem. Eng.*, April 7, 1958, p. 137), the thermal efficiency of the heating unit is not dependent upon the coefficient of emissivity. Principal effect of the coefficient of emissivity is the amount of area of emitter required to transmit a given amount of heat in a unit time.

If we assume, for the purpose of illustration, that the coefficient of absorptivity of the material being heated is 1.0 for the energy being transmitted, then the area of the heating unit required to transmit heat at a given rate will be inversely proportional to the coefficient of emissivity of the radiant-heat source.

$$q = i_f \sigma (T_1^4 - T_2^4)$$

where q is in Btu./hr.-sq. ft.

In this example σ, T_1 and T_2 are all held constant and q is proportional to i_f. Then, in this case,

$$\frac{1}{i_f} = \frac{1}{e_1} + 1 - 1$$

or $i_f = e_1$. Therefore, q is proportional to e_1 and total heat transferred in a given length of time would be proportional to:

(e_1) (Area of radiator)

Two Important Applications

Of the many possible applications of radiant heating equipment, let's focus our attention on two of the most important: removal of moisture; and fusing of plastic film.

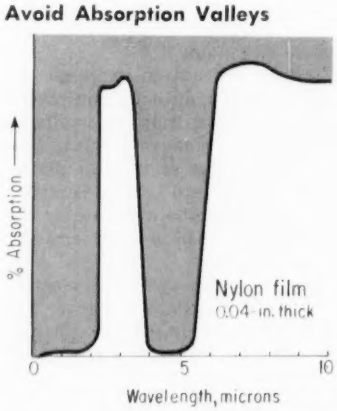
First, let's examine the case where we want to remove moisture. Water is a good absorber for radiant energy of wavelength greater than 1.4 microns (see *Chem. Eng.*, April 7, 1958, p. 139, Fig. 4). This means that we should be able to obtain a fair thermal efficiency with 2,800-F., gas-fired ceramic units and that good thermal efficiencies should be obtained with lower-temperature emitters.

However, infrared lamps would give low efficiencies at best.

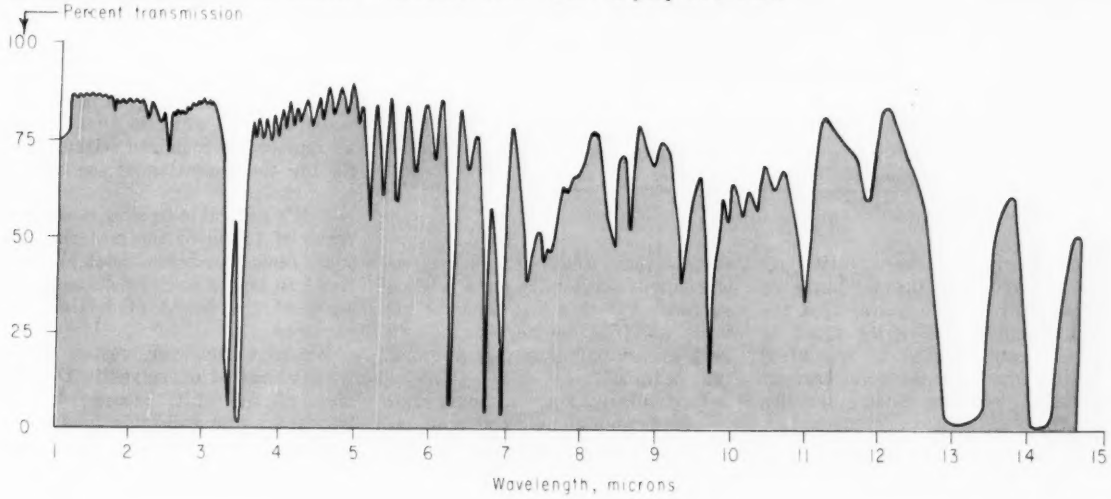
From here on in the problem becomes primarily one of economics and space. Thermal efficiencies in the order of 20% may be expected from use of gas-fired radiant heaters and thermal efficiencies on the order of 80% have been obtained with the lower-temperature electrically heated units.

Your author has seen cost ratios of electricity to gas of from 2-to-1 up to 10-to-1 (on a therm basis), so there are areas where each type of heat source could be justified from the standpoint of fuel. Equipment cost and payout policy would also have to be considered here. We have assumed that the drying will be done on a continuous basis with the material to be dried passing in front of the radiant heater at a

Avoid Absorption Valleys



It Would Be Difficult to Match a Source With This Polystyrene Film



constant velocity. Problems such as casehardening, shrinkage, etc., will not be discussed here, but if information concerning the specific material to be dried is not available, laboratory tests would certainly be advisable.

When using infrared heat for drying—provided the radiation is of relatively long wavelength—the bulk of the energy will be absorbed by the moisture and there will be very little penetration of the rays into the solid core.

Therefore, the solids will be heated by conduction, and the major portion of the energy will be used to evaporate moisture. This helps to explain the relatively high thermal efficiency of 80% which has been obtained with long-wavelength radiant heating units. It also implies that the vapor must be removed from the heating area soon after it is produced; and indicates that the drying efficiency may be reduced when the moisture has been largely removed.

Fusing of plastics is a much more complex problem than the removal of moisture and, except in cases where reliable operating information is available, laboratory testing is advisable.

With plastics, long-wavelength radiation is usually more effective than short wavelength radiation. (See curve for nylon film, previous page.) In addition to properties shown in the figures of this article, it might be of interest to note that cellulose will absorb only small amounts of radiant energy of wavelengths below 2.8 microns, and vinyl film absorbs only small amounts of radiant energy of wavelengths shorter than 3.3 microns.

This same trend, absorption of long-wavelength radiant energy, will follow for most of the other plastics as well. However, from the transmission curve above for polystyrene film, we can see that it would be almost impossible to match an emitting source to a particular plastic by theoretical means alone.

Try It in the Laboratory

The best approach is to make a small experimental setup in the laboratory (see sketch, next page) and perform a series of tests. At each temperature setting, you should try a number of different conveyor speeds to obtain information on the effect of exposure time vs. temperature.

Then you may be able to reach some conclusion as to the most effective combination of temperature and time.

There are, of course, many factors which will influence the most effective time and temperature combination and a different plastic, or a different thickness of the same plastic, will probably require a new setting of time and/or temperature. Too high a temperature or too long a time at that temperature may result in blistering the plastic.

Also, the solvent may have to be removed before the plastic is fused, to prevent blistering. This depends on the thickness of the material. If a coating is being fused, blistering may occur if too short a wavelength energy is used. The short-wavelength energy may heat the backing material instead of the plastic. In addition, if too much time is taken in bringing the coating to the gelling temperature, cracking may result.

If the plastic is brought to temperature too quickly, blistering or shrinking of the film may result. All of these possible difficulties indicate the advisability of a series of laboratory tests and the value of a considerable amount of test data before the production unit is designed and constructed.

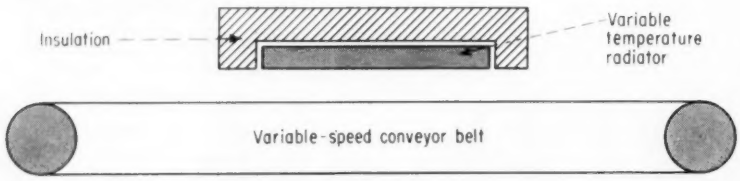
Here's A Specific Case

A specific example may help to illustrate the application of the principles of radiant heating.

Consider the case where the quality of the product is paramount, so that the amount of heat used, and therefore the cost of generating that heat, is of secondary importance. This type of problem is encountered when we want to fuse a vinyl coating applied in the form of a plastisol. To make the problem even more illustrative, let's assume that the backing material is an asphalt-saturated paper felt.

This means that if we apply any

Here's a Simple Lab Testing Outfit



excessive heat, severe blistering will result from the bubbling of the asphalt. It also means that the heat which we do apply must be largely concentrated in the vinyl coating and that the total amount of heat applied must be controlled carefully.

There are three possible ways to apply the required heat:

- Conduction. By means of heated, polished rolls.
- Convection. By directing a flow of heated air on to the surface of the material.
- Radiation.

The first two methods should be investigated before a final decision is made, but consideration of the problems of safety (possibility of fire), quality of goods, control of the process and the cost of the installation continue to provide a balance in favor of radiant heating in many cases.

First step in our analysis is to obtain what information we can concerning the properties of the vinyl coating. We know, for example, that a clear vinyl will absorb very little radiant energy below 3.3 microns. A quick glance at the chart at the beginning of this article indicates that the source temperature should probably be below 1,300 F. to successfully handle all colors of coating, including clear, without excessive heating of the backing material.

This would indicate a source such as a radiant glass panel, glass-wound resistance wire, or a heated plate of some sort or another. Glass and glass-mat surfaces have an upper temperature limit of about 750 F. We can safely tolerate a 1200-F. source temperature, which is the upper limit of a common strip heater. We shall, of course, have to supply essentially the same amount of heat to the material, regardless of the source temperature.

A glance at our table of emissivities shows that an oxidized steel surface has a slightly lower coefficient of emissivity than a glass surface; but this difference is not great and for the purpose of this very preliminary analysis, we shall ignore it.

Particularly, since in some cases the coefficient of emissivity of oxidized iron surfaces approaches that of a glass surface at the temperature we are working with, and also because the amount of the difference will not affect our findings materially.

We know that for the same coefficient of emissivity, the heat transferred by radiation in a given time will be proportional to:

$$A\,(T_1^4 - T_2^4)$$

This means that if we assume T_2 to be 300 F., the area of a 750-F. source would have to be almost four times the area of a 1,200-F. source for an equivalent rate of heat transfer.

Considerably more space would then be required for the lower-temperature source. The probability is that the lower-temperature emitter—with an equivalent Btu. output—would be considerably more expensive than would the higher-temperature emitter (since costs can frequently be compared, in a very rough manner, on the basis of surface area). An additional feature favoring the higher-temperature source is the amount of space required for the heating unit in the production line.

Here the costs of installation can be roughly equated on an area basis.

Our Final Design

The heating unit could then be composed of a heated iron sheet with an oxidized surface and an insulated back. The way in which the surface was heated would have no effect on the radiating properties of the emitter.

For simplicity's sake, let's construct our source from a number of strip heaters connected in banks of a few kw. each with each bank being controlled by a controller to keep the source temperature from rising too high. Each bank can be made up as a unit, so that it can be replaced or repaired without affecting the operation of the heater as a whole.

If it's desirable to slow down the speed of travel of the material for some reason or other, heat production can be cut back by cutting out some of the banks of heaters as required.

We have, however, gotten somewhat ahead of ourselves in the design of the unit, because before we design the full-scale heater we should check the effects of different source temperatures on the material we are fusing and we should determine the exposure time required at different temperatures.

This can be done in a laboratory setup, such as the one shown above, by varying the temperature of the radiator and then adjusting the speed of the conveyor belt so that samples of the plastic to be fused emerge from under the radiator in the condition desired.

Having selected the most desirable source temperature and the time required for satisfactory fusion, it is a simple matter to determine the length of heating surface required to fuse the particular plastic at the desired speed.

To Sum Up

This has been a brief—and in some places an almost cursory—review of the fundamentals of infrared heating and infrared heating units. No attempt has been made to draw any definite conclusions since this would be impossible without a knowledge of all the factors affecting a specific case.

Each application is different because of the type of material, thickness of material, speed of production, cost of energy, equipment on hand, or some other reason. In the final analysis, the controlling factor will be the economics of the operation.

However, we believe that consideration of the factors discussed in this two-part article will help the engineer to arrive at the most economical and effective radiant heating system possible for his particular application.



WHY,
WHEN and
WHERE . . .

Pilot Plants in Process Technology

First of a series on pilot-plant practice, to include articles on unit operations, equipment and safety, and final scale-up.

E. L. CLARK, Consulting Chemical Engineer, Pittsburgh, Pa.*

FOR MANY YEARS the pilot plant and its place in the development of new processes and products have been popular subjects in technical journals. Articles have dealt with design, construction economics, operation and even philosophy of the pilot plant. However, so many references available to the chemical engineer tend to become more confusing as their number increases. On top of this is a tremendous variation in opinions put forth by these writers on size, complexity and almost every other definitive dimension of the pilot plant.

All this is understandable since each pilot-plant program is designed to fit a particular situation and bring it to industrial realization in the most efficient and economical manner. We can therefore anticipate wide variation in approach and facilities on account of the differences in economic and technical factors inherent in each process or product.

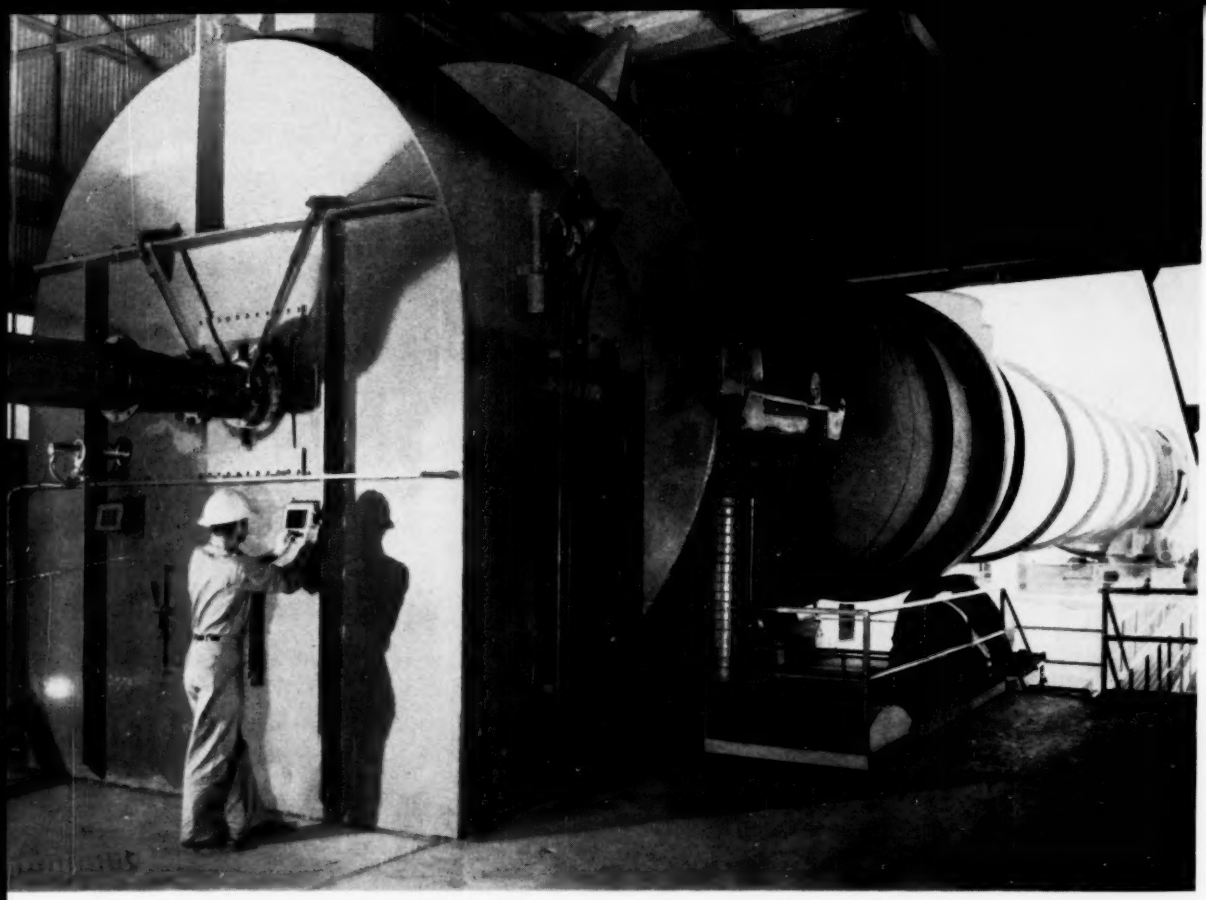
In spite of these differences, there are over-all similarities of purpose and concept which permit us to establish general rules governing all pilot-plant experimentation. There is general agreement that the purpose of the pilot-plant program is to reduce the risks—both technical and economic—when commercializing a process or product. Dr. Baekeland's familiar admonition—to make your mistakes on a small scale and your profits on a large one—epitomizes this idea.

We also find general agreement that pilot-plant costs are considerably higher than those for laboratory research, and that a pilot-plant program is time-consuming and expensive. The question is often raised whether the time gained by skipping the pilot plant program may not be more valuable than the risks of changes in the final production unit.

Pilot Plants in Applied Research

To avoid attempting to separate a research program into distinct areas by definition, we can use a simple and common example. Let us take the case in which Raw Material *A* is subjected to a number of conversion steps to produce Product *B*. The process has been explored in the laboratory and reported through the normal channels. An economic evaluation indicates that Product *B* may be sold at a price sufficiently greater than the cost of Raw Material *A* to pay for the conversion steps and return a satisfactory profit on the capital investment. Furthermore, there is a satisfactory existing long-term market for Product *B*, or evidence of a need such that a market can be developed. Raw Material *A* can be easily obtained so production of *B* is decided to be a worth-while activity. The pilot plant stage has begun.

*Meet your author on page 186.



Diamond Portland Cement Co.'s 3,500 bpd. kiln (story on p. 60),scaled up about 160:1 from . . .

There is the possibility that a careful evaluation of existing knowledge and literature may convince us that enough is known to design the production unit immediately. The pilot plant stage then consists of the conversion of available information to the design parameters for the industrial plant. In this case no pilot-plant experimentation is necessary.

Processes for Sale

Another possibility is that we may lack sufficient knowledge for a particular conversion step within the process, but the missing "know-how" has already been acquired by some other chemical company, engineering firm or consultant. In this case we may decide to purchase the information and avoid the time and expense of additional investigation. Again, little or no experimental work will be needed. Since the effort needed to obtain the design data has been completed and used for several applications, the cost to each user may be considerably less than the cost of his own experimentation would have been, even though the seller profits through the multiple use of his "know-how."

This type of approach is common in the petroleum industry where a refiner may utilize several patented processes in the conversion of crude to specification liquid fuels. In fact, he may furnish samples of his raw material to various engineering firms who will supply him with detailed experimental results in order to sell him their particular process.

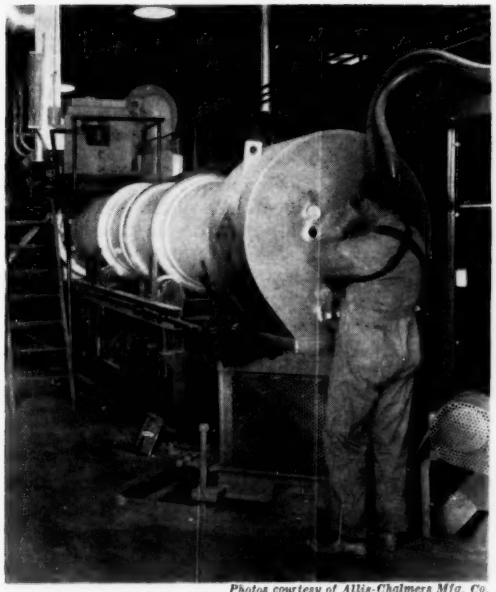
The most interesting and challenging situation occurs when insufficient information is available to design an industrial unit. Then the information must be obtained by additional experimentation. The need for additional data is an economic one. Remember that some sort of preliminary design basis has been established in order to evaluate the economics of the process. A hypothetical plant has already been roughly estimated, based on laboratory data. But we are unwilling to proceed with construction because we dare not risk investing capital for the expected return without more certainty of the cost and profitability of the plant.

During pilot-planting, as we obtain more data, we may become sufficiently convinced of our original belief in the profitability of the process. Again, unfortunately, the conviction may come that the process is not satisfactory for industrial use. Thus we must constantly re-evaluate our original estimate to avoid going beyond the point at which a decision can be made.

To stop an experimental program is often more difficult than to start it. There is a tendency to inject personal feelings and to extend the work beyond the point of economic advisability for emotional reasons, always hoping for a "breakthrough." This is an expensive luxury for an applied research group.

The indefinite approach we are taking, places the pilot-plant stage somewhere between the laboratory and the commercial plant. It also supplies a partial definition for the starting point of the pilot-plant program. It is that point at which our thinking and experimental pro-

Full Scale from Pilot Plant



Photos courtesy of Allis-Chalmers Mfg. Co.

Allis-Chalmers' 300-400 lb./hr. pilot kiln.

gram become oriented towards obtaining information specifically for final commercialization of the project.

To Pilot or Not?

The record shows a number of cases where commercial plants were constructed entirely on the basis of laboratory data. One of the most commonly cited examples was the synthetic rubber program during the early years of World War II. For producing butadiene by the dehydration of normal butylene, almost all of the commercial reactor units were designed from data obtained in 1- and 2-in. diameter reactors holding 100 to 500 cc. of catalyst. Construction of the production plants was well along before a larger reactor of several cubic feet catalyst volume was available to recheck the design data. Fortunately, no major changes in design were necessary as a result of this check.

The success of this procedure is difficult to evaluate. Seven plants were built based on the same catalyst and feed stock. Four different reactor designs were employed, involving variations in both mechanical arrangements and differences in space velocity, catalyst bed dimensions and catalyst volume. The results were as follows:

- **Reactor A** — Almost no changes needed, only minor delays encountered in reaching full plant production.
- **Reactors B and C**—Changes required in catalyst bed geometry were readily made due to simplicity of reactor and availability of excess catalyst capacity. These reactors were oversized for the plant production expected. Delays resulted in reaching full efficiency and utilization of feed stock, but not in attaining design production.
- **Reactor D**—Major changes required in reactors and operating variables. More than six months' delay in reaching designed plant production.

If we make the reasonable assumption that the construction and operation of a pilot plant would have taken 1 yr., it is obvious that considerable time was saved by not waiting for pilot-plant results. Since this was the prime factor during the emergency period when loss of our rubber supply was imminent, the decision to proceed with plant construction without pilot-plant data was obviously correct.

Considering the results from an industrial point of view, one can see that the plants based on Reactor *A* were completely successful in bypassing the pilot-plant stage. Actually, the larger of the two plants using this type of reactor was the lowest-cost producer of butadiene. The plants using Reactors *B* and *C* were also successful in bypassing the pilot-plant stage from a technical point of view. These were somewhat over-designed plants and they were higher in cost.

The plants using Reactor D met considerable technical difficulty. In this case these plants had the lowest capital investment per unit of production. However, the lower capital cost was achieved at the expense of combining several functions and complicating equipment. This resulted in less flexibility of operation, greater difficulty in making necessary changes and loss of production.

Another common example, where pilot-plant operation is said to have been bypassed, was the development of the processing steps leading to production of nuclear weapons. Again the stimulus of a war-time urgency put a high premium on time. In spite of this urgency, however, many of the processing steps were evaluated in pilot-plant units concurrently with the construction of the production units. The boldest extrapolation seems to have been made in the plutonium recovery plant at Hanford. This plant was designed on the basis of laboratory data obtained with micro-gram quantities of plutonium.

Example of Hanford

H. D. Smyth in his famous "Smyth Report," tells us that the original design of the Hanford plant was based on a precipitation process which gave promise of minimum risk of extrapolation. Furthermore this process could be separated into a series of steps or cycles in which similar equipment could be utilized. This limited the amount of equipment develop-

ment and permitted major changes in operational sequences without too much difficulty. Again we see the approach based on simplicity and flexibility to insure against major equipment alterations in the production unit. Obviously, since initial operation of this plant, many changes have been made as a result of improved extraction and separation techniques.

We can see from these examples that it is possible to bypass the pilot-plant program and proceed to the design of a production unit. It is possible to save considerable time in this way. Even where substantial delays are encountered in plant operation, there can still be a worthwhile time saving considering the many months usually required for pilot-plant design, construction and operation.

Doubtless, as our understanding of unit operations, unit processes and equipment design improves, the hazards of large extrapolations can be reduced. Each process obviously must be considered on its own merits in deciding whether it is possible to bypass the pilot-plant stage.

The one point we must stress is to avoid complex, inflexible units when making large extrapolations. It is better to accept some loss in heat recovery and labor utilization in order to achieve more flexibility in operation and simplicity in equipment. Furthermore, there must be some premium on time to justify the risk of skipping over the pilot plant. Even brief delays in reaching production of a large industrial plant can easily cost more than a rather extensive pilot-plant program.

What is a Pilot Plant?

So far, we have dodged the normal procedure of defining our subject before discussing it. There is a good reason for our hesitation. With so much variety in pilot plants, it is clear that only a functional or methodological definition is possible. Jordan, in "Chemical Pilot Plant Practices" (Interscience, New York, 1955), states rather simply that "A pilot plant is a plant that pilots; it points the way; it furnishes data and experience to aid in the difficult transition from research to commerce." However, he admits that this is too broad a definition and then modifies it to a more usual description of a "scale model of a larger chemical plant built of engineering materials."

C. T. Montross, in his article in "Encyclopedia of Chemical Technology," Vol. 10, pp. 696-711 (Interscience, New York, 1953), comments that "The point of view of the engineer, chemist or executive usually establishes the limits applied to the term 'pilot plant'."

This statement gives a clue to a potential definition which may be restated as "A pilot plant is what you think it is." We are discussing a stage or phase in the sequence of process or product development. The pilot-plant stage may refer to one or several experimental units of varying complexity, size or time of operation. However, all are of identical purpose—to reduce the technical and economic risks to the point where capital investment appears attractive and a reasonable return can be foreseen for the risks involved. Thus, we are discussing an extremely practical and functional period in which economic appraisal must be the primary yardstick and the profit-loss statement the final criterion of evaluation.

It is difficult to define strictly the starting point and in some cases the end point of the pilot-plant stage. All we can do is list a set of postulates to which there may be many exceptions.

- The pilot-plant stage begins when the experimental work becomes oriented towards providing process, design and technical data for commercial production.
- The pilot-plant stage may include both laboratory and bench-scale experimentation, as well as the operation of prototype or scale-model plants.
- The pilot-plant stage ends when the economic gain possible through continued experimentation becomes sufficiently small.

In setting up these descriptive postulates, we are attempting to be more inclusive than restrictive. We specifically include laboratory experimentation in our second definitive point to emphasize and underline the importance of cooperative effort in this stage of process development. We also avoid stipulating the end of the pilot-plant stage at the time of operation of the commercial plant. Many production problems and decisions in the early operating period involve capital risks which may be diminished by added experimentation. While this type of work may be considered as "technical service" rather than "pilot plant," it is usually a continuation of process development by the same group and in similar equipment.

Another type of pilot-plant work often neglected by the literature is the study of an existing plant operation. Here a process step or an equipment item in an operating industrial plant requires further study. The engineer must set up a suitable experimental unit which will duplicate the existing larger installation to provide data for improvement of operations. This is a sort of reverse size-extrapolation and an important aspect of applied research activities. In such a case a direct measure can be made of the improvement through research. It is another example of the variety of activities which are covered by the pilot-plant phase.

What Pilot Plant Functions?

The functions of the pilot-plant stage we have rather arbitrarily divided into four general categories. Although they could easily be subdivided or combined, they provide a convenient organization for our discussion.

1. *Process Information*—By this term we mean a knowledge of the main chemical reactions or physical changes of the process—in short, the effect of process variables on product yield and capital investment. It is obvious that these data can be obtained in units of various size. Often the pilot-plant stage merely re-examines in greater detail the most attractive area for commercial exploitation as shown by previous laboratory research in the *same* or other laboratory equipment.

2. *Effect of Size and Geometry*—This function appears in direct contrast to Function (1). In many cases our knowledge of various effects is so imperfect as to make large extrapolations extremely risky. In addition, we always have the problems of effect of temperature and composition variations, and hold-up, to consider.

Unforeseen effects of geometry can be important. Rushton et al. (*Chem. Eng. Progress*, 52, 319-23, 1956), discussing the effects of

multiple mixing turbines on gas-liquid contacting, showed that two turbines mounted on a single shaft, and sufficiently close together to cause interaction, may give poorer results than a single turbine and produce queer flow patterns. Oldshue, at Rose Polytechnic's Biochemistry Symposium in 1953, showed that either poorer, equal or better results could be obtained with multiple than with single turbines. This suggests that we should prefer to test on a relatively larger scale those reactions that depend on mixing for the control of either gas-film or liquid-film resistances.

It is worth noting that Jordan (*loc. cit.*) recommends that the size of batch (stirred) reactors be in the 100- to 200-gal. size range, since anything less will not be representative of industrial practice. This consideration is also important when a stirred vessel is used to precipitate a material which will require filtration. The type of crystal and the filterability of the slurry depend to a great and often unpredictable extent on the mixer, baffles and geometry of the reaction vessel.

3. *Engineering Design Data*—This topic covers a tremendous variety of information. It deals with many diverse types of experimental data. The ever-present problems of corrosion and materials of construction may be extremely important in some processes, dictating the amount of capital investment required, and calling for long and laborious materials-testing programs to find a suitable economic compromise. Much work of this type is carried out in the Atomic Energy program where considerable funds have been invested in "materials testing reactors." These are used to investigate less expensive structural and auxiliary materials which can withstand heat and radiation and thus reduce the capital cost of future atomic power units.

In another process, variations in viscosity of an intermediate product might be of critical importance to the engineer designing heat exchange or fluid transfer systems for that particular plant section.

Many requests for engineering data develop along with the need for providing more accurate estimates of plant capital cost, and determining how much various portions of the process contribute to total investment or operating costs of the process. At this point the applied research department may be asked about substitute materials, more exact data on physical or chemical properties of materials in process, and whether certain combinations or interchanges in the actual processing steps might be possible for greater economy in energy, equipment or operating staff.

4. *Quality Control*—The primary purpose of most applied research is to develop a way to supply a product which can be sold. This usually means that the item involved in the transaction must be carefully identified, described and specified. Sometimes this is relatively simple. In other cases, rather complex testing methods are required. The same problem exists for all raw materials needed for the process, since their quality may seriously affect the product characteristics.

Consider a development problem in which determination of product quality is relatively simple—a chlorine-caustic cell, which uses brine as raw material and produces chlorine and a 50% solution of caustic soda. The development work may have been done with pure salt solution, but the commercial cell will be operated on natural salt which may contain magnesium and calcium salts and require purification. If any anolyte recirculation and resaturation system is used, as in mercury cell operation, the anolyte will require purification after addition of salt.

Design of the purification system will be a function of the tolerance of the process and product for the various impurities. The purity of the chlorine and caustic soda solution can easily be specified and determined. There is no need to provide samples of chlorine for testing by prospective customers. This is true also for caustic soda, except that possibly viscose manufacturers may demand particularly low salt contents as part of their purchasing specifications.

A quite different problem exists in the paint and plastics industries. If we are planning to produce a resin component, its action and quality will have to be determined by various prospective customers as a function of their products. Each customer will probably insist on testing our product in each of his own formulations before agreeing to purchase any large industrial quantity. Part of the pilot plant stage will therefore involve producing enough material to test its marketability. As we learn more about the action of various intermediate products, we may learn how to forecast accurately their performance by analytical techniques—but this millenium is still in the future for many substances. Where actual usage is still

Announcing a Comprehensive Series on

Pilot Plants in Process Technology

I. The present article: Why use a pilot plant; when a pilot is not needed; what a pilot plant actually is; where piloting starts and ends; what it accomplishes; problems of scope, size, design, location and personnel.

II. Unit operations in the pilot plant: How the pilot plant engineer uses the unit operations concept; which unit operations most probably will need piloting.

III. Equipment and safety in the pilot plant: How the pilot plant engineer chooses equipment and construction materials; how he provides for safety in equipment design and operation.

IV. Data correlation and scale-up: How the pilot plant engineer uses the data gained in the pilot plant, via data correlations, size-extrapolation and scale-up procedures, to provide information for full-scale plant design. This last, to appear October 6, is to be a full-scale feature Report.

the only criterion, we must include sizeable test facilities for product utilization as well as large pilot production units to provide samples as part of the program.

Pilot Plant Problems

In attempting to answer the question of "What is a pilot plant?" we dodged the issue and replied that it is what you wish it to be. Now it is time to consider the problems of this phase of industrial research by asking "When?" and "How?" and "Where?" and "Who?". The questions of optimum Timing, Design of Equipment, Location and Personnel are difficult ones. To complicate the situation, their answers are often related since available personnel may set the time, location and type of equipment.

Again, the relationships of causative factors may be inverted. In many cases the type of process, as well as the personnel or equipment problem, will exert a definite influence. Just as the definition of a pilot plant avoids any restrictive descriptions, we must avoid too many axiomatic statements as to where pilot plants should be located, how they should be designed, when they should be started or stopped, or what type of personnel should be assigned to them.

Scope—The experimental area to be covered by a pilot plant program should be carefully determined. Not all portions of the process may require additional information. Those areas which have greatest effect on cost, and greatest uncertainty, should be emphasized. Careful study of the economics of the process may reveal that only one or two steps really need extensive study. Even so, these steps will usually require running through the entire process. It seems that they are always in the middle of the flow sheet, such being the perversity of experimental work. Still, we may often find that a few tests in available or easily assembled equipment will remove enough uncertainty to make the plant design technically and economically feasible.

In deciding on the scope of the pilot plant, the chemical engineer has an unusual opportunity to apply his special training. The unit-operation concept permits a careful evaluation of each process step in the light of known correlations and data available on the particular unit operation under consideration. This approach will be discussed in the second article of this series.

Size—The size of an experimental unit depends on the type of information desired and the process or operation under investigation. For the present we shall set only the lower and upper limits of size.

Obviously, quantity of product obtained in any chemical or physical change should be sufficient to permit analytical determination of its quality, together with changes in quality caused by variations in processing conditions. This is an obvious minimum, but it requires evaluating the analytical procedures available. By decreasing the sample size needed, the analytical laboratory may aid in reducing the necessary size of the unit or increasing the number of data periods each day. In either case this materially decreases the cost of the program.

The need for producing sample quantities of material for detailed testing by potential customers may dictate the upper-limit size of the experimental unit. Very often large semi-technical units are constructed with this purpose in mind during the period prior to industrial plant operation.

The problem of size extrapolation merits rather extensive discussion as a separate topic. Since a pilot plant unit must furnish data for a larger operation, it must bear some relationship to the final industrial plant. It is essentially a "model" and to be a good model the results must be applicable to the larger but similar object which is being tested. Further discussion of this topic will conclude this series.

Design—The general design of the pilot plant is an extremely important factor in its success. Most difficulties in pilot plant experimentation arise from mechanical and equipment inadequacies. This is particularly true in large, complex prototype plants where the aim is to produce sample quantities of material. Valves, pumps and piping arrangements are responsible for more delays in the program than problems of chemistry. Since these delays are costly, and particularly so in a potentially profitable venture, considerable effort is justified in detailed design and selection of components for experimental units.

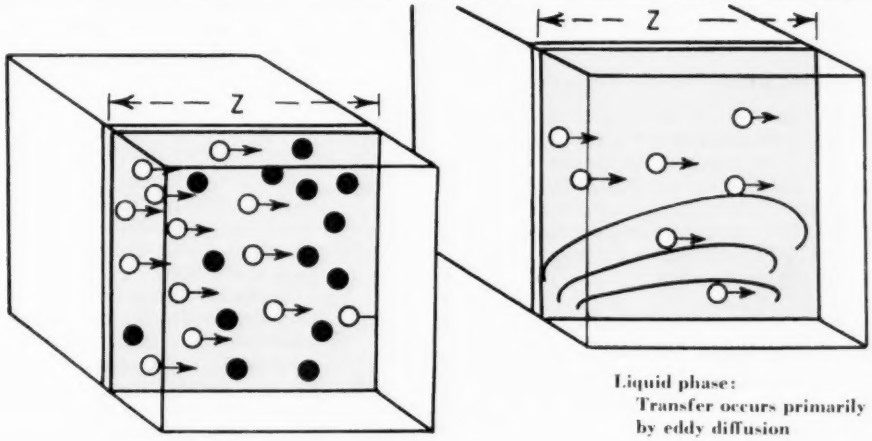
This will be the third topic of this series.

Location—Where to put the pilot plant unit varies with the type of unit. For example, small experimental installations requiring a great deal of analytical work might preferably be located in the research group. On the other hand, large complex units can often take full advantage of a location within a production area where ample utilities, operating and maintenance personnel, and storage facilities are available. Of critical importance is a proximity to reliable analytical services. We can tolerate a great deal of effort in shipping feed stock or product if this will avoid sending samples for analysis and then having to wait for the laboratory report.

Personnel — Successful pilot plant work requires a great variety of personnel. The most important ability in addition to professional competence is that of being able to work cooperatively with others. The analyst, research chemist, engineer, operator, maintenance man, statistician and clerk must all lend their talents to successful prosecution of the program. Chemical engineers are ideally suited to this work by their breadth of interests both in pure chemistry and in the pursuit of various engineering sciences.

Economic Function Is Dominant

In our discussion so far, we have introduced our subject by outlining the functions and problems of those areas of applied research activity which we have defined as the pilot-plant phase. And we have considered examples where the entire pilot-plant program was successfully bypassed. The most apparent characteristics of a pilot-plant program are the numerous types of experimental work that may be needed, and the difficulty in setting up any definite procedures. The primary function is an economic one, to insure the productive use of investment capital with a risk commensurate to the potential profit. Costs of both the experimental program and the future industrial plant are the dominant theme.



Mechanics of Mass Transfer

How to establish mathematical relations and how driving forces, equilibrium conditions and resistances influence mass transfer.

JAMES O. OSBURN, State University of Iowa, Iowa City, Ia.*

Understanding the underlying principles of mass transfer is often helpful for the intelligent selection and application of processing equipment. Last month, *Chem. Eng.*, Mar. 24, 1958, p. 145, we reviewed the general characteristics of mass transfer. Now we'll examine the driving forces that cause mass transfer to take place.

What Makes Mass Transfer Work

Mass transfer takes place by the motion of molecules. We find this motion taking place within a single phase whenever there is a concentration difference. To a large extent the motion is described by the diffusion equation:

$$\frac{\partial C}{\partial \theta} = D \frac{\partial^2 C}{\partial Z^2} \qquad (1)$$

The term D is the diffusion coefficient whose dimensions are length^2/time. The term C is concentration, θ is time and Z is the length of the diffusion path.

We can integrate Eq. (1) under a variety of conditions to give useful equations. For some of these see "Mass Transfer Operations," R. E. Treybal, McGraw-Hill Book Co., New York (1955). However, these solutions involve the assumption that only molecular diffusion is taking place.

* To meet your author see *Chem. Eng.*, Mar. 24, 1958, p. 168.

Usually, molecular diffusion is helped by gross movement within the phase. This movement is known as eddy diffusion. As a matter of fact, if we want to measure the molecular diffusion coefficient, we find that one of our biggest difficulties is to eliminate eddy diffusion.

Concentration Difference Aids Diffusion

Because of eddy diffusion, we can't often use the molecular diffusion equations to describe mass transfer successfully. However, we can use them to point out some of the characteristics of mass transfer.

For example, let's consider the equation for the diffusion of two ideal gases through each other. Also let's assume the same number of moles of each gas are diffusing. For this case, the equation is

$$N_A = \frac{D_A}{RTz} (p_{A1} - p_{A2}) \qquad (2)$$

Note in this equation that the number of moles transferred N_A is directly proportional to the partial pressure difference; and inversely proportional to the distance through which diffusion of the gases takes place.

Here, we see that the partial pressure difference is the driving force for diffusion. In a gas, the partial pressure of a component is a measure of

the concentration. We can generalize from this case and say that the rate of mass transfer varies directly with the difference in concentration. The concentration difference is the driving force for mass transfer within a phase.

Stagnant Films Hinder Diffusion

If concentration difference is the driving force for mass transfer, what is the resistance? In general, we can say that resistance is caused by collisions of diffusing molecules with other molecules. Another of the diffusion equations shows this relation. The relation for the steady-state diffusion of ideal gas A through a stagnant gas B is given by the following equation:

$$N_A = \frac{D_A P}{RTzp_{BM}} (p_{A1} - p_{A2}) \quad (3)$$

Our illustration shows this situation. Here, as before, the driving force is the partial pressure difference.

Acting to decrease the rate of diffusion is the quantity p_{BM} which is the log mean partial pressure of the inert gas. It's defined as

$$p_{BM} = \frac{P_{B2} - P_{B1}}{ln\,(P_{B2}/P_{B1})} \quad (4)$$

The resistance to diffusion in this case is the combination of the distance z and the effect of the inert gas.

We will find an application of this equation in mass transfer where one phase is essentially pure. Such a case might be the absorption of a pure gas, or the saturating of one liquid with another partially miscible one.

For the pure phase, p_{BM} approaches zero. We find in such cases that the resistance to mass transfer in the pure phase is negligibly small. Of course, in Eq. (3) N_A is finite because for a pure phase $(p_{A1}—p_{A2})$ is practically zero.

How Diffusion Occurs in Liquids

We can write similar equations for liquids and solids, using mole fractions and concentration units instead of partial pressures. We also eliminate the term RT which is characteristic of ideal gas calculations. Eq. (2) becomes

$$N_A = \frac{D_A C}{Z} (X_{A1} - X_{A2}) \quad (5)$$

Also, Eq. (3) becomes

$$N_A = \frac{D_A C\,(X_{A1} - X_{A2})}{X_{BM} Z} \quad (6)$$

Diffusion is slower in liquids than in gases and the higher density of liquids means that eddy diffusivity is relatively more important. We modify the diffusion equation by including the eddy diffusion coefficient E_D as the following equation shows:

$$N_A = \frac{(D_A + E_D)\,(C)\,(X_{A1} - X_{A2})}{Z} \quad (7)$$

Again our illustration shows how the two types of diffusion contribute to the total mass transfer.

The eddy diffusivity E_D depends on the degree of turbulence or the conditions of flow. It is difficult to evaluate E_D. We don't usually try to separate D_A and E_D, nor can we measure the film thickness in most cases. Consequently we group these three terms together and correlate them empirically. We'll discuss some of these correlations in a later article.

Mass Transfer Between Phases

So far we've been dealing with the movement of material within a single phase. Most mass transfer operations, on the other hand, involve transfer from one phase to another. Let's see how the two subjects are related.

In transfer from one phase to another, there are actually three processes taking place. First, molecules travel by molecular and eddy diffusion from the bulk of one phase to the interface between the phases. Second, they get across the interface. And finally, they diffuse into the other phase.

The diffusion to and from the interface is a single phase transfer. We have already considered the factors which affect this motion. Now we can examine the situation at the interface.

Driving Force Is Zero at Equilibrium

Actually, the existence of an interface is a logical hypothesis, since we can't actually measure or observe the conditions right at the interface. We know that there is a sharp concentration gradient, where one phase changes to the other. But we aren't quite sure whether the zone of transition extends one molecule or 100 molecules into the phases. The depth of this zone makes a difference in the interfacial resistance.

When we consider equilibrium, we are on surer ground. At equilibrium, there is no net transfer, so the composition of a phase is uniform. The compositions of phases in equilibrium are related to each other in some way; but in general they are not equal. Since there is no mass transfer, there must be no driving force. If the phases are not at equilibrium, mass is transferred at a rate depending on the displacement from equilibrium.

Since equilibrium is so important to mass transfer, let's look at some of the equilibrium relationships which we can use for the different operations.

Equilibrium Relationships

In distillation, we use the familiar vapor-liquid equilibrium diagram for two-component equilibrium. We commonly use mole fractions for concentration units. This is particularly helpful if we use Raoult's law for calculating equilibrium from vapor pressures. Rauolt's law is written

$$y_A = \left(\frac{P_A}{\Pi}\right) X_A \quad (8)$$

Likewise, with a constant relative volatility the mole fraction units are convenient. The equation of the equilibrium curve is

$$y_A = \frac{\alpha x_A}{1 + (\alpha - 1)\,x_A} \quad (9)$$

However, if we make experimental measurements and use the enthalpy-concentration diagram for calculations, the units are weight fractions. In this case, the extra labor of calculating mole fractions does not give any advantage.

In absorption we must use more care in choosing units. Equilibrium is expressed as

p	(pressure units)	vs. c	(lb./cu. ft.)
p	(pressure units)	vs. C	(lb. moles/cu. ft.)
y	(mole fraction)	vs. x	(mole fraction)
y'	(weight fraction)	vs. x'	(weight fraction)
Y	(weight ratio)	vs. X	(weight ratio)

We must be familiar with methods of conversion of units to be able to use all of the preceding relations.

Let's examine the dimensional quantities that we often use in some of the mass transfer operations.

A useful correlation for absorption equilibrium is Henry's law. We find Henry's law in a variety of forms including:

$$p = Hx \quad (10)$$

$$p = H'C \quad (11)$$

$$C = H''P \quad (12)$$

$$y = mX \quad (13)$$

$$Y = MX \quad (14)$$

In extraction, the weight or mole fraction in one phase is plotted against that in the other phase. Concentration units in lb./cu.ft. are also used. The distribution coefficient is the ratio of the weight fractions of the solute in two phases.

$$m = y/x \quad (15)$$

Adsorption equilibrium is usually given as weight or volume of adsorbate per pound of solid against partial pressure, mole fraction or concentration in the fluid phase.

For crystallization and dissolving the equilibrium relations are the solubility diagrams. We will find these in units of mole fraction, weight fraction and in weight per unit volume. Some of the equilibrium relationships are shown in the adjoining diagram.

When using equilibrium data for mass transfer we must be able to handle a variety of units.

Gas Diffusion Is Different

Gas diffusion is unique because it is a non-equilibrium process. The separation obtained when a mixture of gases diffuses through a barrier depends on a difference in the diffusion speed of the gases. Only when there is motion do we obtain fractions with different compositions. However, we may plot pseudo-equilibrium diagrams as shown. These diagrams show how the mole fraction in the permeated gas depends on that of the gas which remains. Although this isn't true equilibrium, we can use it to calculate the number of stages just as we do an equilibrium process.

What Happens at the Interface

We have equilibrium at the interface when two phases are in equilibrium. But what if the phases are not at equilibrium?

Equilibrium Data: A Complex of Units

Distillation

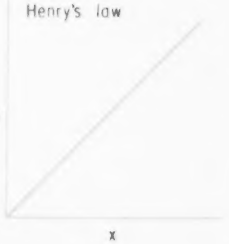
Mole fraction is usually most convenient

$$y = \frac{a\,x}{1+(a-1)x}$$

Absorption

Variety of units plague calculations

Henry's law



$p = Hx$ H = atm./mole fraction
$p = H'C$ H' = atm./lb.–cu.ft.
$c = H''p$ H'' = lb./cu.ft.– atm.
$y = mx$ m = mole fraction / mole fraction
$Y = MX$ M = mole ratio / mole ratio

Adsorption

Freundlich equation

$$\frac{W}{M} = kp^{\frac{1}{n}}$$

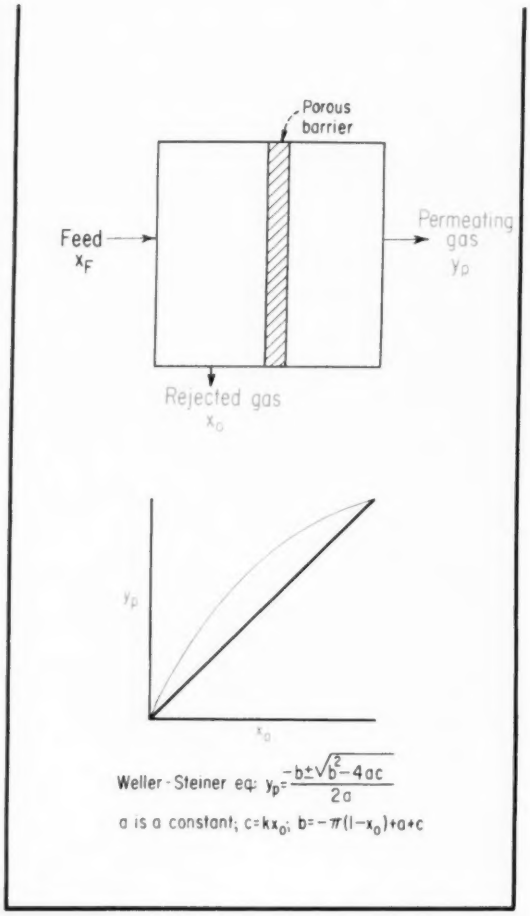


Brunauer–Emmett–Teller equation

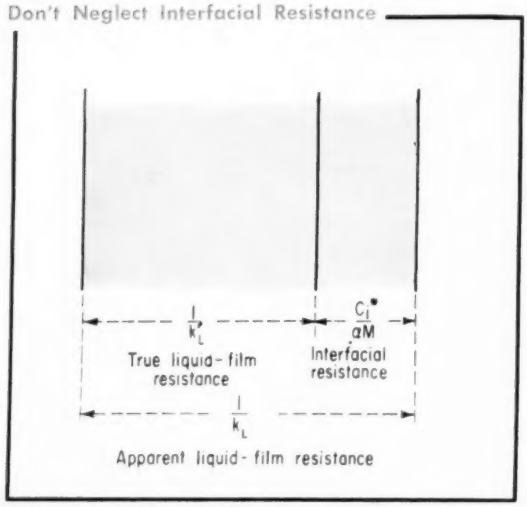
$$\frac{p}{V(p_o-p)} = \frac{1}{V_m a} - \frac{(a-1)p}{V_m a p_o}$$



Pseudo-Equilibrium Useful for Stage Calculations



Don't Neglect Interfacial Resistance



Most design calculations make use of the two-film theory. We assume that there is equilibrium at the interface under all conditions, and that all resistance to mass transfer is in the fluid on either side of the interface. This assumption works all right for most purposes. If there is any interfacial resistance, it can be lumped together with one of the fluid film resistances without being detected or causing any trouble.

In certain cases, however, we can detect an interfacial resistance and should include it in our calculations. In the previous article *Chem. Eng.*, Mar. 24, 1958, p. 145, we mentioned three cases of this kind. Let's look at one of these cases more closely to see the effect of interfacial resistance.

An article published by Emmert and Pigford [*Chem. Eng. Progress*, **50**, 87-93 (1954)] describes a method for including interfacial resistance in absorption calculations. Only a fraction of the solute molecules which reach the interface actually gets across to the other phase. This fraction is named the accommodation coefficient with the symbol α. Values of α are amazingly low, being in the order of 10^{-8} for the absorption of carbon dioxide in water.

We separate the liquid film coefficient into two parts. One results from the resistance to diffusion in the liquid and the other due to interfacial resistance. In terms of film coefficients,

$$\frac{1}{k_L} = \frac{1}{k_L'} + \frac{c_i^*}{\alpha M} \qquad (16)$$

k_L = Apparent liquid film coefficient.
k_L' = True liquid film coefficient.
c_i^* = Liquid phase composition in equilibrium with gas phase.
M = Moles of gas striking a unit area of surface per unit time.

We calculate M from kinetic theory by the equation

$$M = \sqrt{\frac{1}{6}}\, C_G u \qquad (17)$$

where C_G is the concentration in the gas phase and u is the root means square velocity of the gas molecules.

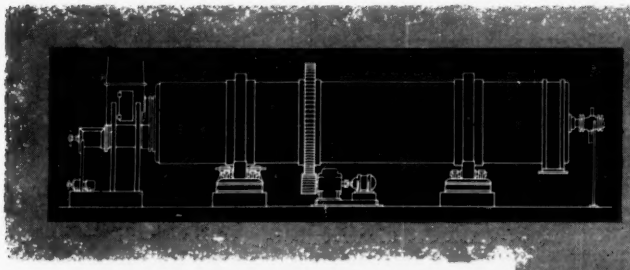
The adjoining diagram shows how the interfacial resistance adds to the other resistances.

We won't need to worry about accommodation coefficients if we use rate data which were determined under conditions similar to those we plan to use. However, if we are trying to extrapolate data, it would pay us to examine accommodation coefficients more closely.

Coming: How to Use Mass Transfer Rates

In this article, we show a picture of what is happening in the mass transfer operations. The picture is that of molecules diffusing to an interface, getting across the interface and diffusing into the other phase. This situation is common to all mass transfer operations.

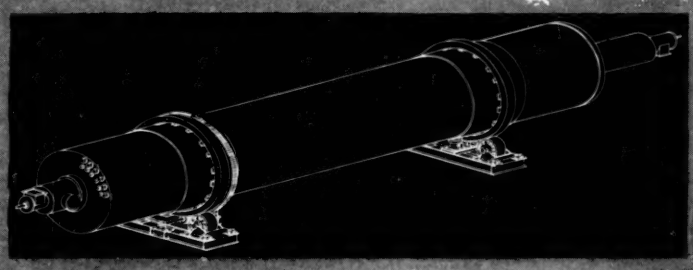
Our next article shows how to use this concept in writing rate equations for constant conditions and how to use these equations in various situations.



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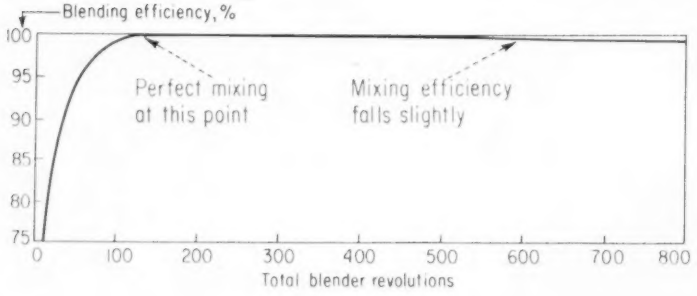
Louisville Dryer engineers will work with you—study your materials and needs, make recommendations for type of equipment, size and heating medium. You can check these recommendations for yourself through practical tests. Your Louisville Dryer is then engineered for most efficient and economical service—built specifically to meet your needs.

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Simple Statistics Beats Blend Problem

Unawed by newer mathematical techniques this plant saved a $75,000 investment by a simple statistical approach.

L. E. Louraine
Monsanto Chemical Co., Texas City, Texas.

Many articles have appeared recently on linear programming, operations research and response models. In the rush to learn and use these more exotic techniques is seems that many people have forgotten the older methods of control charts and "sigmas."

At Monsanto we recently used only the simplest statistical approach in solving a blending problem, which realized a considerable increase in plant capacity, plus a large saving in capital expenditure. So, it seems worthwhile to recall that old-fashioned statistics may still be useful in many cases.

The Problem—Past practice in blending a certain polymer had been to blend for a time equivalent to 400 revolutions of the blender. With this blending time we found that a planned capacity increase would require another blender, plus conveyor and electrical extensions, all of which would have meant an approximate $75,000 capital expenditure.

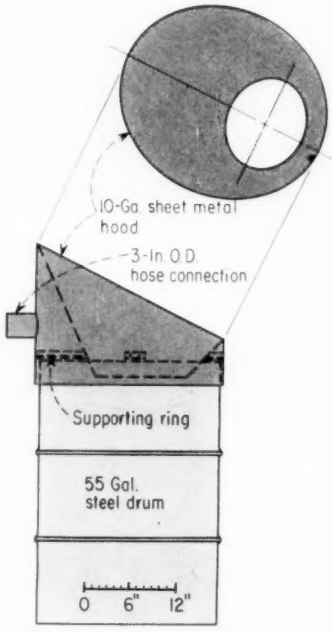
The Solution—Plant experience had indicated that this blend time was much too long. Our problem was to demonstrate this and show whether blend time could be reduced without a decrease in the quality of product.

We devised an experiment involving the blending of a 50-50 mixture of black and white polymer cubes. In several runs we used blending times equivalent to 5, 10, 30, 50, 100, 200, 400 and 800 revolutions. At the end of each time we stopped the blender and took ten 0.5-lb. samples at various random spots in the blender by means of a put-and-take scoop attached to a long handle.

With each sample we separated the black and white pellets and weighed the individual components, calculating blending efficiency from the ratio of each component in the samples. Sigmas were calculated for each set of ten samples and these sigmas compared for significant differences. Also, the averages of blending efficiencies for 50 revolutions were compared statistically. We found no statistical significance in these comparisons.

The graph above shows how blending efficiency varied with blender revolutions. An efficiency of 90% was reached after 40 revolutions, and of 100% between 100 and 200 revolutions. After 200 revolutions there appears to be a slight decrease or leveling off in efficiency.

As a result of these experiments we were able to decrease blending time to 200 revolutions. This made it possible to increase throughput enough to take care of the new production requirements and another blender was thus proved unnecessary.



Build a Dust Hood For Drum Filling

P. R. Wiewandt
Process Engineer
Purex Corp., Ltd.
South Gate, Calif.

Sketched above is a drum dust hood which we use on a packaging line where broken and rejected packages of dusty material must be collected. With minor revisions, we have found it adaptable to several applications, including reclaiming product from packages which have to be cut open and put into drums.

The hood is useful wherever

ideas

new ways to solve problems — with chemicals

A NEW FOUNDRY SAND BINDER is prepared from starch, water, a water-soluble urea-formaldehyde and phenol-formaldehyde resin, and a small amount of paraffin wax dispersed in emulsified form. The wax vaporizes at the temperature of the molten metal and decomposes to give carbon at a temperature of 1,000 F.

HIGH PRECISION TEMPLATES ON SHEET METAL can now be made by a photographic method in which the metal surface, coated with a light sensitive substance, is exposed to actinic light through a dimensionally stable, light-transmitting, flexible sheet. This sheet has a glass-fabric base, impregnated with a polyester resin polymerized from a dihydric alcohol of the glycol group. The transmitted image is then developed on the sheet metal surface.

A PATENTED METHOD FOR MAKING BORON NITRIDE BODIES comprises heating a mixture of boric acid and tricalcium phosphate in an atmosphere of ammonia. Minute crystals of boron nitride are formed in the resulting product. These crystals, about 0.5 micron in size, are next placed in a mold and hot pressed to form a boron nitride body having an apparent density of about 2.

A NEW AMMONIA-CONTAINING DETERGENT POWDER said to be stable, free-flowing and non-caking, contains a high percentage of ammonium bicarbonate. Other essential ingredients include small amounts of anhydrous alkali metal polyphosphate and a dry solid surface active agent from the group consisting of alkyl aryl sulfonates.

Allied Chemical

information appearing here is published as a service to readers. Athough we do not make the end products mentioned, we can supply you with these basic chemicals:

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drums are to be filled with dusty materials, provided a dust collection system is available. The amount of air needed for this type of hood is low. For the size shown a flow of 150 cfm. of air will insure a 200-fpm. velocity across the smallest open face of the cone.

The hood is connected to the dust collection system by a 3-in. I.D. flexible hose which, with the lightweight construction of the hood, makes it easy to move from drum to drum and also tends to make it somewhat portable.

The hood is small and requires only a small amount of air for efficient use, owing to its downdraft principle. A person working over it is not required to work in a dusty atmosphere as is the case with most compartment-type hoods.

One Slide Rule Setting Finds Solids Dilution

Merton Allen
Chemical Engineer
General Engineering Laboratory
General Electric Co.
Schenectady, N. Y.

Calculating the amount of solvent to add to a solution or suspension to change the solids percentage from its initial value to some lower value is often cumbersome and may lead to a mathematical error. Here is an easy solution to the problem which can be calculated as simple proportion with one setting of your slide rule.

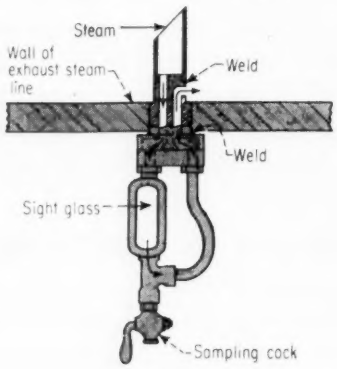
If we let S_i equal the known percentage of solids initially present, S_w equal the desired percentage of solids after dilution, and A equal the unknown percentage of solvent to be added:

$$S_w = 100[S_i/(100 + A)] \quad (1)$$

$$A = 100(S_i/S_w) - 100 \quad (2)$$

$$(A + 100)/S_i = 100/S_w \quad (3)$$

The third form of the equation is used for solution on the slide rule. For example, if the initial solids concentration is 40% (S_i) and we want to decrease it to 25% (S_w), we set 25 on the *D*-scale under 100 on the *C*-scale and find $(A + 100) = 160$ on the *C*-scale over 40 on the *D*-scale. Hence, if $(A + 100)$ is 160, then $A = 60\%$, meaning that if we add new solvent to the extent of 60% of the weight of initial solution, then the final solids concentration will be 25%.



Sight Glass Checks on Exhaust Steam Quality

Richard Minser
Cleveland 18, Ohio

Whether or not exhaust steam from reciprocating equipment such as steam engines, pumps and compressors can be used safely for heating depends largely on how dry it is and whether it contains cylinder oil. If it is wet it may waterlog heating surfaces and retard heat transfer. If it contains oil it can foul heating jackets and coils, gum up valves, and form a heat-insulating blanket throughout the system.

I recently visited a plant that had devised a handy sight glass for checking on the dryness of the steam and on the efficiency of the deoilers or steam separators in the exhaust line ahead of the heating application. It is well to check these factors before making the application. Once installed, it is a good idea to check periodically. Any abnormal showing of oil will mean that the separator should be cleaned, that it is inoperative, or that the quality of the cylinder oil is not what it should be.

The sketch shows how this sight glass is made from standard components, with a little machining and welding.

As the sketch shows, a nozzle machined from a piece of bar stock is screwed into a tapped hole in the steam pipe. A short length of pipe is welded to one end and a manifold welded to the other. The manifold, made from a blank flange, is bolted to another similar flange drilled to connect to a sight glass and to a return line. The sight glass, a standard design, connects at the bottom to a tee and sampling cock, with the tee side outlet return line connected back to the manifold.

When installed some of the steam bypasses through the sight glass which collects both condensate and oil. Periodically the contents is drawn off for analysis. Installing such sight glasses both before and after the separator will shown whether that device is working properly.

COMING MAY 19: Sizing Equipment for Flowsheets

By Robert H. Berg, Winner of the March Contest

★How Readers Can Win

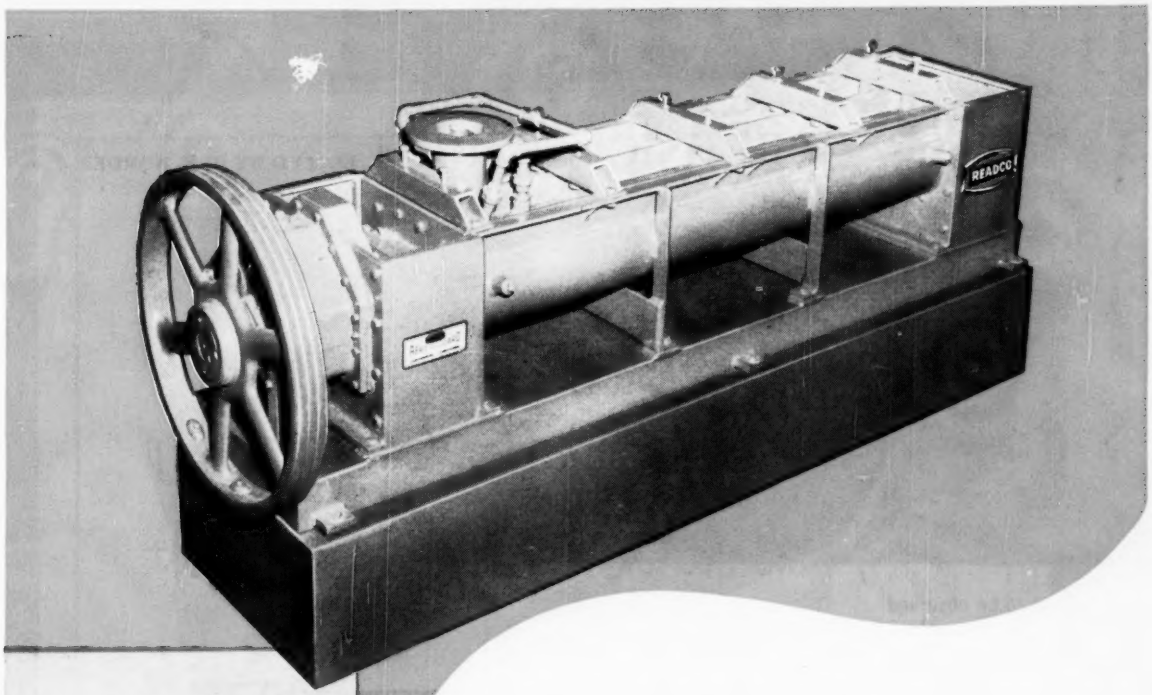
$50 Prize for a Good Idea—Until further notice the Editors of *Chemical Engineering* will award $50 each four weeks to the author of the best short article received during that period and accepted for Plant or Design Notebook.

Each period's winner will be announced in the second following issue and published in the third or fourth following issue.

$100 Annual Prize—At the end of each year the period winners will be rejudged and the year's best awarded an additional $100 prize.

How to Enter Contest—Any reader (except a McGraw-Hill employee) may submit as many contest entries as he wishes. Acceptable material must be previously unpublished and should be short, preferably not over 500 words, but illustrated if possible. Acceptable non-winning articles will be published at space rates ($10 minimum).

Articles should interest chemical engineers in development, design or production. They may deal with useful methods, data, calculations. Address Plant & Design Notebooks, *Chemical Engineering*, 330 W. 42nd St., New York 36, N. Y.





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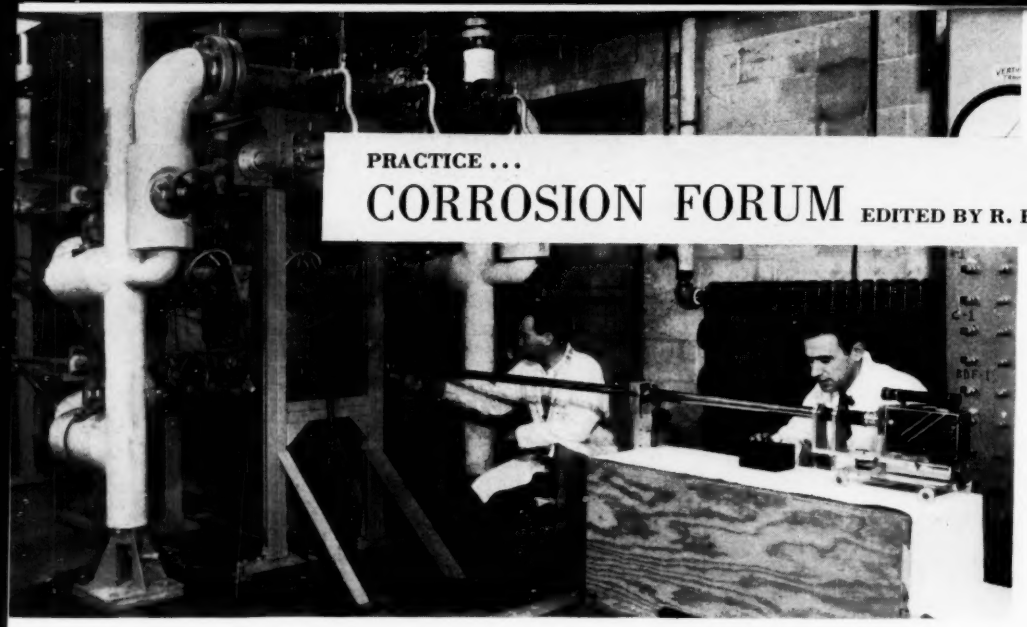
You can step up production and reduce costs of processing dense and viscous materials with this rugged Readco mixer. Built for continuous, automatic operation, it will turn out ½ to 3 cubic feet per minute . . . in a completely homogeneous mix.

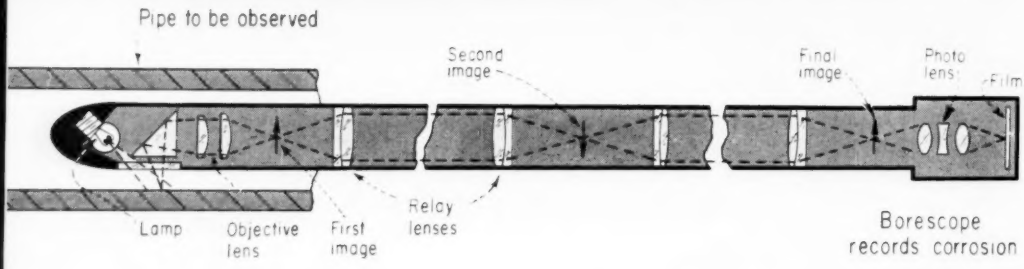
Overlapping action of mixing paddles fully disperses ingredients while moving them along to discharge. Temperature controlling jackets for heating and cooling are standard equipment.

For further information on Readco mixing equipment, see Chemical Engineering Catalog pages 1483 to 1490.

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New Optical Methods Spot Hidden Corrosion

- **Improved borescope takes panoramic photos of corrosion inside pipe.**
- **New technique takes flattened-out picture of cylindrical parts.**
- **Plastic impressions permit study of corrosion in inaccessible areas.**

J. M. Holeman, General Engineering Laboratory, General Electric Co., Schenectady, N. Y.

In many cases it is necessary to make optical measurements of corrosion progress. But the usual methods of photography and microscopic observations leave much to be desired. Many are inaccurate or do not permit getting into inaccessible areas of equipment.

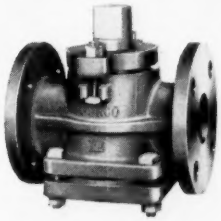
Actually there are techniques and instruments available which considerably increase the scope and accuracy of corrosion measurements—but not many chemical and corrosion engineers are familiar with such specialized equipment.

We hope to remedy this situation here by discussing some of the new and novel practices. For instance:

- Most borescopes for observing the inside of pipes only show a small round area. A big improvement is the panoramic borescope, using a wide-angle lens (*above*).
- An ordinary photograph of a cylindrical object shows about one-third of the surface. An improved technique produces a complete, flattened-out image.
- For very difficult-to-get-at regions it pays to make a plastic impression and take your measurements off this replica.

▶ **Getting Inside Pipe**—In one problem it was necessary for us to document progress of corrosion on the inside wall of a pipe. There are instruments for making such observations, known as borescopes, available as small as 0.125 in. in diameter. Some larger sizes are made in lengths as great as 50 ft.[1] Flexible models can be purchased for looking into curved or crooked bores.[2]

Some manufacturers provide a camera to photograph the image seen through the borescope. In our study both the usual borescope and camera proved to be inadequate — most borescopes show an image of a small round area on the side wall of the pipe.



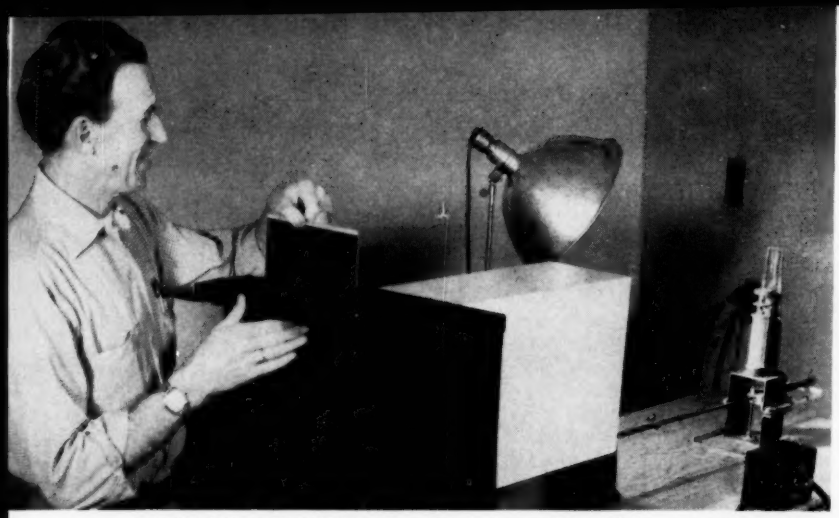
The **Durco type "F"** valve could be the valve you've been looking for!

It is extremely simple in design, has a removable Teflon sleeve and is made in several rugged corrosion resisting alloys. There are thousands of happy users of Durco Type **"F"** valves in the chemical industry.

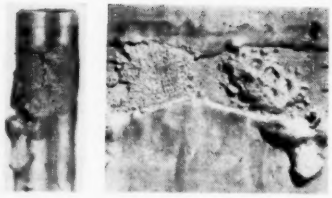
DURCO
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AVAILABLE IN SIZES FROM 1/4" THRU 4"

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ROTATING CYLINDER permits photograph of entire corroded surface.



To photograph the entire inside surface of a pipe 30 ft. long would require several thousand exposures. Even if these could be made, identification of individual areas would be almost impossible.

Optical solution to this problem was a "panoramic" borescope which incorporates an extreme wide-angle lens.

In a single field of view this shows a strip all the way around the pipe interior and an inch or more in length.[3]

To this instrument was added a 16 mm. motion picture camera and a drive mechanism to feed the camera into the pipe at a slow constant speed. When the film is processed and projected, effect is that of travelling through a large well-lighted tunnel.

Not only is all the interior surface well covered, but the gradual advance of the instrument produces a constantly changing perspective of any defect in the surface. This changing perspective, when viewed as a motion picture, gives the viewer a good estimate of the depth relation of surface defects.

▶**Inaccessible Surfaces** — In some corrosion studies it is necessary to view the inside surfaces of small holes at considerable magnification. The normal borescope is limited to about ten times magnification, but in some cases it is possible to build a special microscope which is very long and thin, containing a right angle prism.

There is also on the market a special microscope sold under the trade names Opton[4] and Cycloptic[5] which have much more working distance than a standard instrument. One commercial model allows stereoscopic viewing at variable magnification from 3 to 40 power in the bottom of holes up to 8 in. deep. This is several times as great as the conventional microscope will allow.

It is also possible to rebuild one of these instruments to allow inspection of surfaces as much as 24 in. from the microscope.

▶**Better Cylinder Photos**—In another problem, we had to study the effect of corrosion on the surface of metal cylinders.

Ordinary photographs of the outside of a cylindrical object only show about one-third of its surface. Also, slight differences in lighting or position of the cylinder make a considerable difference in the interpretation of surface defects.

Optical solution to this problem was a special camera with which an entire cylindrical surface can be photographed when it was normal to the lens and under forty-five degree incident lighting. Under these conditions, the surfaces are easily compared and interpretation of the progress of corrosion greatly simplified.

This special camera is called a "development surface" camera and is a relative of the circuit camera used to take group photographs. The first model of the developed surface camera placed the cylindrical section on a mandrel where it revolved about its axis. A camera lens formed a nearly full size image in the camera on a sheet of film wrapped around a wooden cylinder. To limit the area imaged at one time, a $\frac{1}{16}$-in. wide slit, as long as the image, was placed just in front of the film.

Rotation of the object and film were synchronized by gears on their shafts and a connecting chain. A slow speed motor was provided to rotate the two.

Operation of the camera amounted to unrolling the image from the pipe and rolling it on a cylinder of film. After processing, the flattened-out image presented a developed surface picture in which every area was photographed when it was normal to the lens axis. Later models of the camera use flat film in ordinary film holders and are completely automatic.

An external lever now displaces the slit plate a small fraction of an inch either side of its normal position on the lens axis. Two pictures are taken, one with the slit displaced to the right, the other to the left, and when these were processed and printed they can be viewed stereoscopically.

▶**Stereo Views Are Best**—The stereo pictures produced by the developed surface camera, or any other camera can be viewed in a number of ways.

Small prints can be viewed in an old-fashioned postcard-size stereoscope.

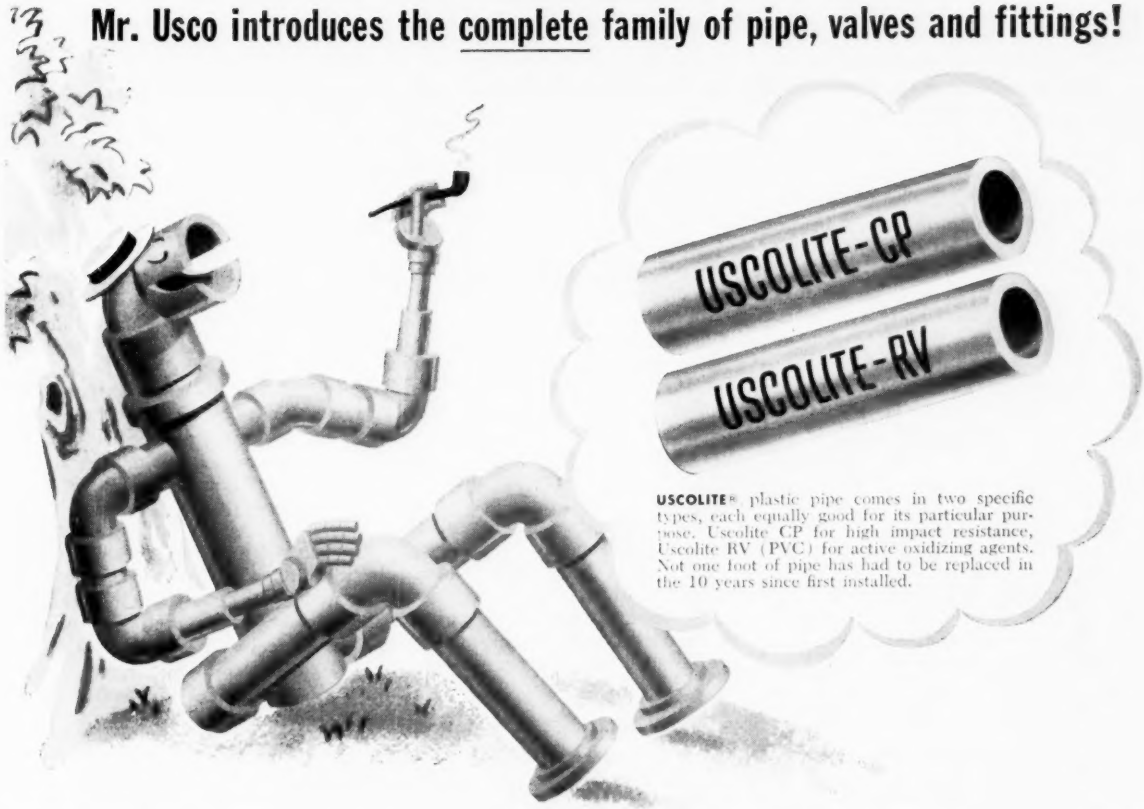
Larger prints or transparencies can be viewed in a stereoscopic medical X-ray viewer such as is sold by several suppliers of X-ray equipment.[6]

Best results have been obtained by using a stereoscope made for viewing aerial photographs.[7] A good instrument will take prints of almost any size and will have variable magnification from one to six or eight power. The lower power allows

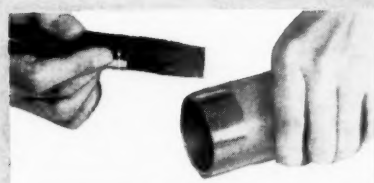
USCOLITE PLASTIC PIPE

PIPE DREAMS come true!

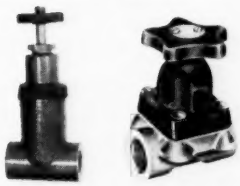
Mr. Usco introduces the complete family of pipe, valves and fittings!



USCOLITE® plastic pipe comes in two specific types, each equally good for its particular purpose. Uscolite CP for high impact resistance, Uscolite RV (PVC) for active oxidizing agents. Not one foot of pipe has had to be replaced in the 10 years since first installed.



USCOWELD* Fittings are the only solvent-weld fittings with an interference fit. Greater joint strength, faster insertion. Non-porous, leak-proof. Made of either Uscolite CP or RV materials.



USCO® VALVES offer a choice of either Hills-McCanna diaphragm valve or Vanton "Flex-Plug" gate valve.



USCOFLOW is a new, black utility pipe, especially suited where low first costs are a factor. It is a blend of styrene-base resin and synthetic rubber for good impact resistance and high tensile strength.

The "Usco" Plastic Pipe Line of precision-molded pipe and fittings for every corrosion and flow problem includes elbows, tees, couplings, flanges, reducing bushings, plugs, caps, nipples, bends.

When you think of plastic, think of your "U.S." Distributor. He's your best on-the-spot source of technical aid, quick delivery and quality plastic pipe and fittings.

* Patent applied for

Mechanical Goods Division

United States Rubber

Rockefeller Center, New York 20, N.Y.

In Canada. Dominion Rubber Company, Ltd.

a general overall view and the high power gives detailed information on any area of interest.

The stereoscope will not allow measurements of depth relationships, but will make it possible to estimate them.

If a standard is prepared with engraved or drilled scratches or pits of known depth, then stereophotographs of this piece can be used to calibrate the user's mental estimation process. With the aid of such a standard, very satisfactory and rapid estimates of depths can be made in the range 0.001 to 0.050 in. By using exaggerated stereopsis and magnified viewing, the range can be extended to estimate depths as small as 0.0001 in.

In cases where mental estimates are not good enough and actual measurements must be made, a different instrument known as a stereocomparator can be used.[8] This device is normally used to make topographical maps from aerial photographs, but can be used for macrophotographs as well. Good quality pictures can be measured to within 0.0001 in. in the third dimension.

▶**Replicas for Tough Problems**—When it is impossible or impractical to build a special microscope to view an inaccessible surface, it is advantageous to replicate the surface and examine the replica with a conventional instrument.

It is quite simple to replicate the inside surfaces of deep holes as small as 0.375 in. (others as small as 0.062 in. have been replicated). Radioactive surfaces can be replicated by remote control and the replicas examined with relatively little hazard.

The simplest way of making replicas is to use cellulose acetate film. This can be obtained in rolls ¾-in. wide.

To make an impression first cut a short length of the film off. Surface to be replicated is wet with a solvent, such as acetone, and the plastic film pressed to the surface with the thumb or a piece of sponge rubber. After ten seconds the film is stripped off and mounted for viewing.

A replica costs less than a cent to make and the process requires little skill.

Replicas form a permanent record of the surface and can be measured, photographed or viewed with a microscope. Detail is almost infinite.

In most corrosion studies the replicas can be studied under a low-power stereoscopic or high-power monocular microscope. The lighting can be transmitted, incident, vertical, oblique, or a combination of these and the best lighting for any particular surface texture has to be found by trial.

It is possible to prepare them further for electron microscope examination and make well-detailed photographs enlarged 75,000 times. These photographs show details as small as a few angstroms.

Replicas of surface defects can be measured with good reliability. In many tests the widths of a large number of scratches were measured both on the specimen and on replicas of the same specimen. In every case the two measurements agreed within 1%. These longitudinal measurements can be made with a travelling microscope[9] or an ordinary microscope equipped with a filar micrometer eyepiece.[10]

Depth measurements, made on replicas, are reliable indications of the actual depths of surface defects existing on the original. Depth measurements can be made with any microscope having an objective with a shallow focus and a calibrated fine focus knob.

Most microscopes will read to 2.5 microns. More sensitive and convenient measurements, however, can be made with a special depth measurement microscope which can be purchased calibrated in either English or metric units and reading to 1 micron or better.[11]

▶**Special Equipment**—Certain types of surface irregularities with low amplitude and more or less uniform undulations are extremely difficult to see either in the original or in replica. Examples of this condition are the "orange peel" surface on plate glass and the "ripple" sometimes seen on certain molded products. Four methods have been developed for viewing replicas of these difficult surfaces:

- Shadowing the replica by vacuum deposition of metal at a steep angle.[12]
- Dyeing the replica.[13]
- Dark field illumination.
- Phase contrast illumination.

Many commercial microscopes can be adapted to the last two methods. Dark field substage condensers can be purchased both in high and low power as standard accessories. Phase contrast accessories are now generally available.

A variation on these two viewing methods are dark-field and phase contrast projection. Unfortunately, there is no commercial equipment particularly suitable for this purpose but it can be made by anyone familiar with the optical principles.

The projected image has the advantage that it can show a low degree of magnification in length and width but variations in the depth dimension will be amplified several hundred times. Under these conditions it is easy to detect slight etching which may extend over a large area.

Two special microscopes[14, 15] are available for measuring gradual changes in surface topography.

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or galling and corrosion-resistant problems ☐

investigate castings made with

Waukesha

metal 23* or 88*

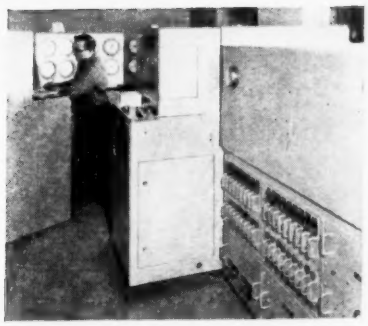
Perhaps you've tried heat treating 400 Series stainless steel alloys to solve your galling difficulties . . . and found the metal has become so hard it can't be machined. Or perhaps serious distortion occurs.

Perhaps you've tried various other alloys and found they don't measure up for *every* performance requirement . . . Either non-galling characteristics or high corrosion resistance are difficult problems separately. Combined they are an impressive engineering headache.

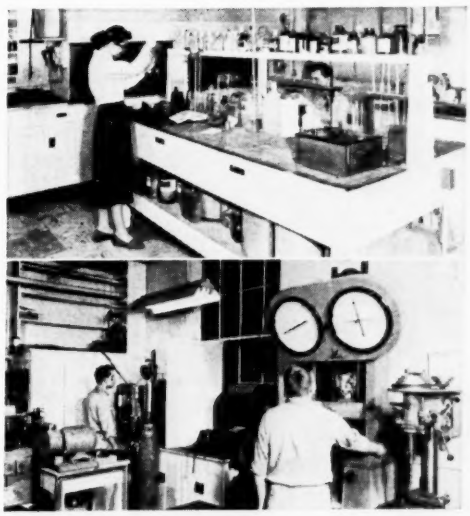
But WAUKESHA Metal 23 or 88 provides non-galling performance even under high speed metal-to-metal contact AND both are highly corrosive-resistant. Both are remarkably free-machining, without hard or soft spots. Both are homogeneous in texture.

WAUKESHA 23 and 88 have solved many of the most difficult casting problems in a great range of industries. We're glad to supply you with a list.

Or better still, write us. Describe your problems and the conditions which must be met. More than likely we'll have the answer for you.

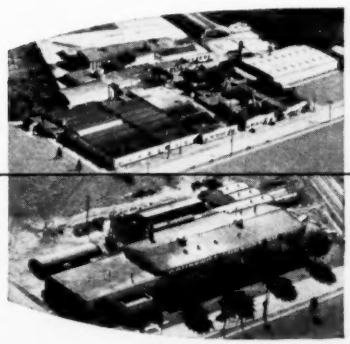


A spectrometer checks every heat. Changes can be made before metal is poured.



Two views of the Waukesha Metallurgical Laboratory — one of the most complete in the country.

* *So unusual and different are WAUKESHA Metals 23 and 88 that patents have been granted on both formulations.*



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Watertown (Wis.) Plant

Waukesha

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THEY *get to take a last look inside*

Standard Oil research develops method for inspecting lubrication of enclosed parts without disassembling

What if you had to make a final inspection of enclosed parts to be sure they were lubricated and you could not do it without disassembling? Standard Oil research scientists have just developed an instrument system that determines lubricant level in an instant. The device measures the density of an assembly so precisely the presence or absence of the desired quantity of lubricant registers on a meter.

Having such a unit might permit you to shorten an assembly line or reorganize assembly operations for greater convenience, speed, economy. The research men at Standard who developed this inspection method will be glad to share their know-how with you to help you fit it to your assembly operations.

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Chemical Engineering

People

APRIL 21, 1958

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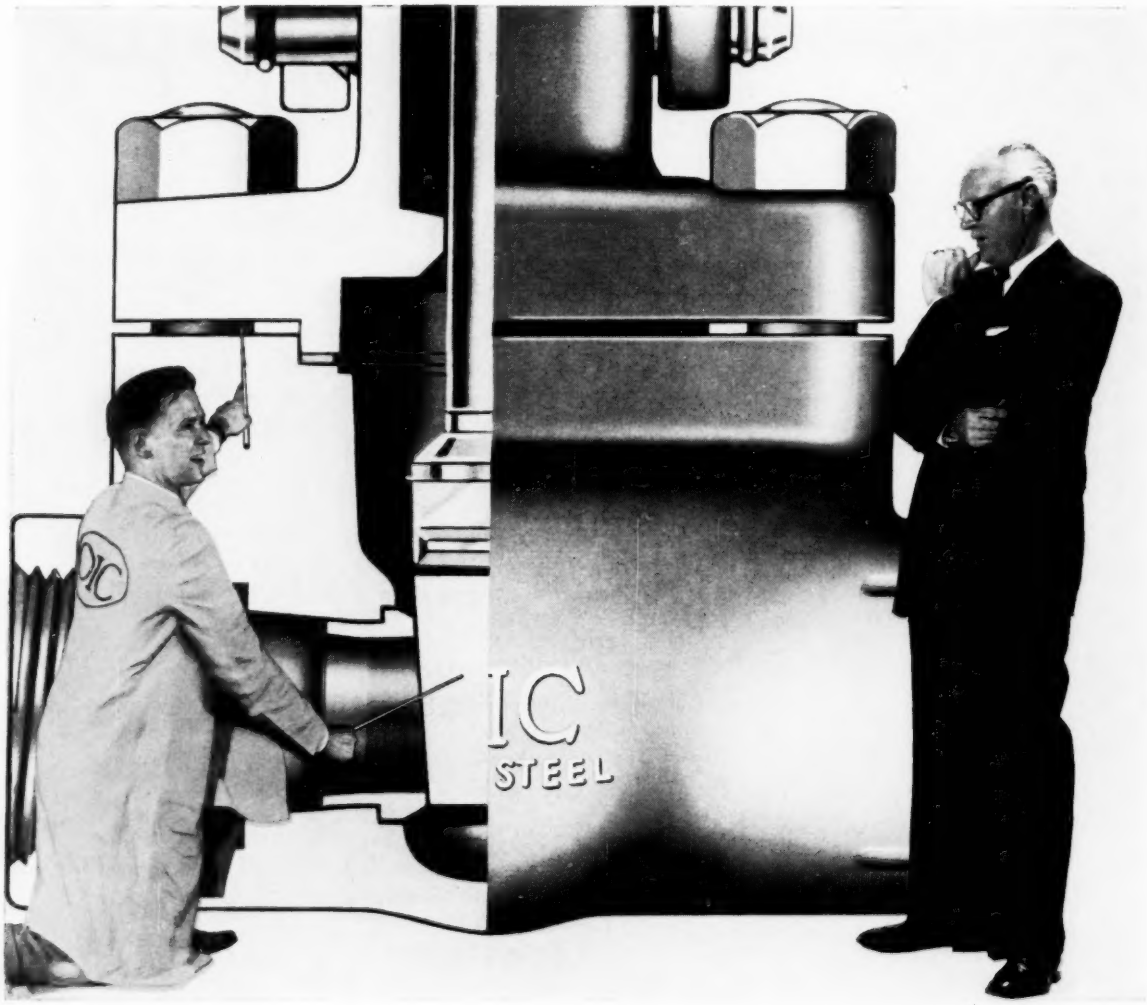
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Modiglass Fibers' Piero Modigliani speaks at the opening of new research and development center, on "The Role of Creative Research in a Product Development Center."

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Goodyear will soon turn out Videne, new polyester laminating film at Apple Grove, W. Va. facility . . . Texas Eastman boosts polyethylene capacity at Longview, Tex., plant.

...and you can see here....and here, sir,
how we've killed maintenance problems
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It's True: The Man Can Make the Job!

Here's why a recent report describing the pay policies of one large company may be important to you, no matter what your job, no matter where you work.

Somewhere along the way, this writer took a graduate course on the other side of the campus in the Dept. of Industrial and Management Engineering. The title was "Job Evaluation Methods."

We started with fundamentals and I can still remember the two basic ground rules of the course:

1. Evaluate the job, not the man in the job.

2. Job description is a discipline unto itself. It is not necessarily a basis for position evaluation or for salary review.

Quickly, some of the students lost interest in whether a milling-machine operator should be placed in Job Level 9 or Job Level 10. We were more interested in how to evaluate the respective duties and responsibilities of process engineers, project engineers, etc. The learned professor —an outstanding authority in the field of job and position evaluation—assured us that, although very little had been published on the evaluation of professional positions, the ground rules would still hold true.

Evaluate the position, not the present incumbent of the position.

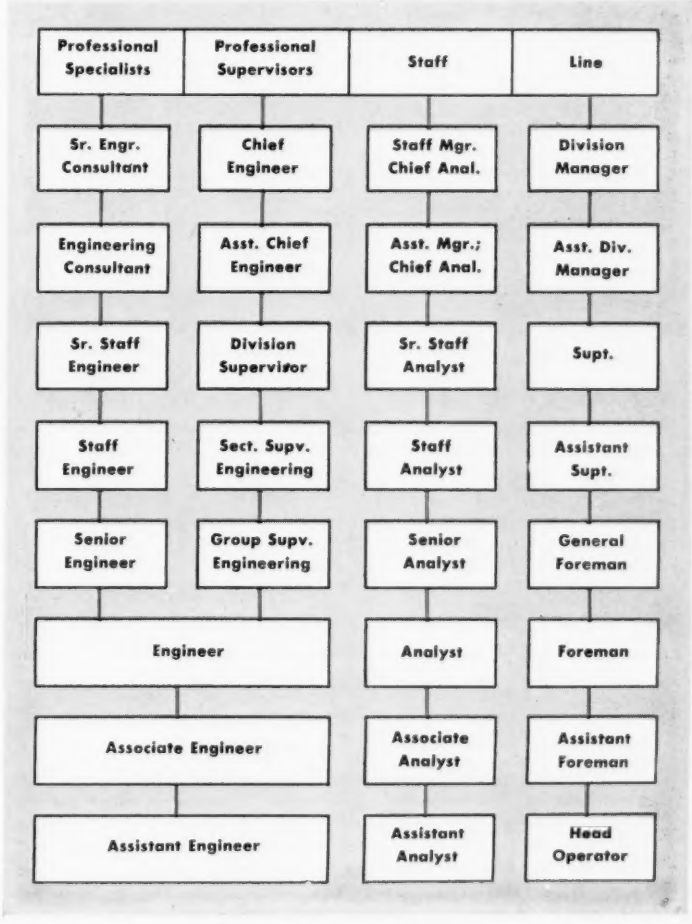
Here's a New Approach

Recently we were sent a review copy of a booklet by the Standard Oil Co. of California entitled, "People and Pay Checks." Prepared by Standard's Dept. on Organization, "People and Pay Checks" includes details of job descriptions, methods of job evaluation, design of pay structures and administration of pay plans.

To most chemical and petroleum companies that have to deal with labor unions, this type of information in the hands of union delegates could be a potential thermonuclear bomb. Yet, Standard of California has chosen to make this information public and circulate it to all its supervisors to be passed along down the line.

Here's why, in the words of T. S. Petersen, President, and R. G. Follis, Chairman of the Board:

"In Standard of California, it has always been basic policy to pay well and to pay fairly. . . . To pay fairly is not as simple as one might think. In a large organization, orderly—and sometimes rather involved — policies and practices are also required. These policies and practices easily acquire an air of mystery to the people most concerned, those who get the pay checks. We know of no good reason for mystery about



pay policies and practices in the Standard of California family of companies, hence this book."

Evaluate the Man

Certainly, this is a refreshingly novel approach by management. Publication of the study, alone, is a significant forward-looking step.

However, for you as an engineer working in a professional capacity, this publication contains two other far-sighted concepts that represent some pioneering in our industry.

In Chapter 15, "Career Pay for Professionals," we find these questions on the place of a professional man in a large company:

In general, how do career opportunities, in terms of pay and recognition, compare for professional men in our company and elsewhere? Can a highly valuable professional man progress in the Standard of California family as a professional specialist as well as he can as a supervisor or as an administrative man?

To answer these questions satisfactorily, a formal and official ladder of advancement was established for professional specialists, paralleling the structure for supervisory and management positions. *(See chart, previous page.)* And organization and job evaluation concepts were broadened, especially in the application of "the man can make the job" thinking. For professional specialists, emphasis is now placed on evaluating the qualitative factors of "men in jobs."

A Rule Vanishes

Sitting in that industrial engineering course many years ago, we questioned—silently, though—the rule proposed by our learned professor. We believed then, and we heartily agree with Standard of California now, that professional men create their own professional positions.

A ground rule has vanished. Some day engineers may no longer be charted on the same scale with lathe hands.

YOU ARE

. . . an Old Oddball

Despite the tremendous upward surge in public awareness of science, most of the nation's young people would not like to be scientists, and many high school students look upon scientists as being different from other people.

Recent studies by Purdue University social scientists show these astounding results:

- 34% of the nation's high school students believe that scientists cannot have a normal family life.
- 38% think scientists are willing to sacrifice the welfare of others to further their own interests.
- More than half believe that scientists take no thought about the consequences of their work; and 54% think that scientists are more likely to be "radical" than other people.

IMMIGRATION

. . . of Professional Men

Almost 60,000 immigrants classified as professional, technical and kindred workers entered the U.S. for permanent residence during fiscal years 1953 through 1956 (July 1952 to June 1956).

According to the National Science Foundation in a just-released report, engineers constituted the largest occupational segment of the incoming group. We gained 9,245 engineers of all kinds during the period covered. Of these, 448 were chemical engineers and 1,092 were mechanical engineers.

Over 40% of the professional group came directly from Europe, with the United Kingdom and Germany providing the largest numbers.

Canada, however, was the largest single source.

NLRB RULES

. . . on Chemical Assistants

A claim of professional status under the Taft-Hartley definition for an assistant in a chemical laboratory has been denied by the NLRB; but the board did hold that a chemical assistant is a technical employee, to be excluded from a bargaining unit made up of clerical, production and maintenance employees.

NEW UNION

. . . Gets Off the Ground

Attune your ears to a new name in the engineering union picture. The Engineers and Scientists Guild (a break off from Engineers and Scientists of America) has now adopted a constitution, a tentative budget and a provisional slate of officers.

Founders of ESG claim to represent a total of about 20,000 engineers, scientists and technicians.

ENCOURAGING

. . . Upswing in Jobs

Lockheed Aircraft Corp. has opened an additional office in New York for the specific purpose of recruiting 600 engineers and scientists in the New York area this year.

Throughout the U.S. in 1958, Lockheed's Missile Systems Div. plans to hire more than 3,000 technical people—both engineers and scientists—for work on the top-priority Polaris and a number of extremely advanced missile projects.

Queried by *CE*, a Lockheed spokesman estimated that of the 3,000 new jobs about 10% will go to chemists or chemical engineers. An encouraging sign of spring.

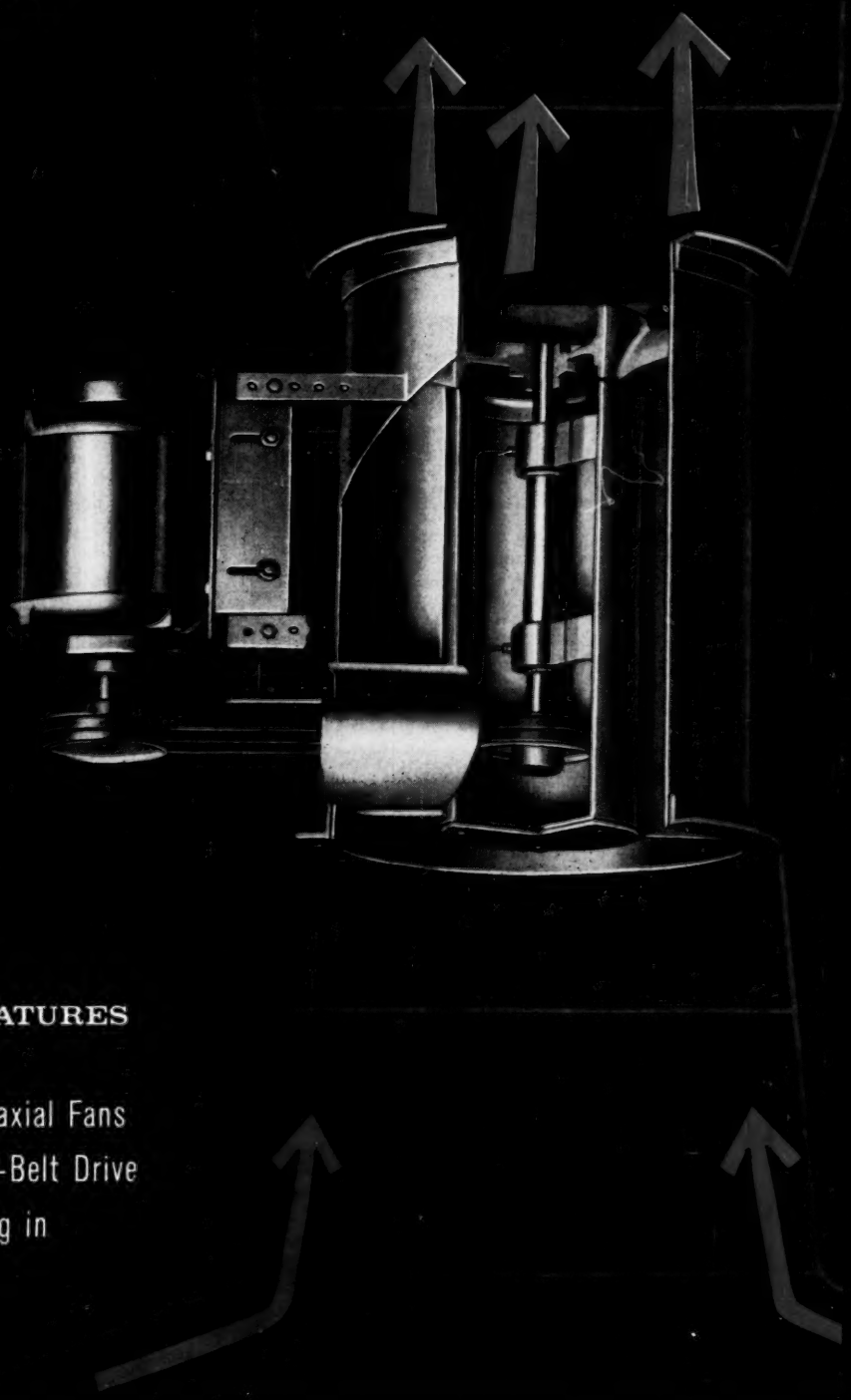
Next Issue: Why I Chose a Government Job

Careers for chemical engineers in government service are often lightly regarded by the general public and by many members of the chemical engineering profession. But, did you realize that more than 1,000 chemical engineers work for Uncle Sam? What do they do? Where are they located? Can they find satisfying and rewarding work in the civil-service atmosphere? For answers, see You & Your Job next issue. A government chemical engineer has his say.

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TECHNICAL BOOKSHELF

J. B. BACON

Chem-E Thermo

THERMODYNAMICS FOR CHEMICAL ENGINEERS. By Harold C. Weber and Herman P. Meissner. John Wiley & Sons, New York. 507 pages. $8.50.

Reviewed by Ju Chin Chu, Professor of Chemical Engineering, Polytechnic Institute of Brooklyn.

There are very few books published in chemical engineering thermodynamics in recent years. Weber and Meissner's text on "Thermodynamics for Chemical Engineers" presents an up-to-date treatment of the subject. The book is a useful text at both undergraduate and graduate levels.

▶ **Practical Problems** — Numerous illustrative problems are given throughout the book to serve as study aids. Practical and interesting problems are given generously at the end of each chapter. These problems, which are good examples of translating laboratory data into economical methods of industrial processing, represent one of the outstanding features of the book.

▶ **A Bigger Book**—The present edition is expanded about 50% over the first edition. No mathematical technique beyond calculus is employed in the various quantitative methods of treatment.

▶ **Applied Laws** — The book is organized in twenty-four chapters. The first ten chapters treat the three laws of thermodynamics and their related principles. The next fourteen chapters deal exclusively with the engineering and scientific application of three laws of thermodynamics.

Notable examples are engineering application of fluid flow, power cycles, engines and turbines, refrigeration, solutions, homogeneous and heterogeneous equilibrium, chemical equilibrium and electrochemical effects. Descriptive material, as well as quantitative treatment, are given for these various applications.

▶ **Open Systems** — Since many engineering devices, such as internal combustion engines, distilling columns, steam boilers and rockets, operate as open system, a complete chapter was devoted to its discussion. The first law of thermodynamics was extended to cover both unsteady and steady state flow operations. The overall energy balance is extended to the system of multiple streams.

▶ **Estimation** — In many engineering problems it often happens that the thermochemical data are lacking for the computation. In the text, both a generalized and specific method of estimation are given for the estimation of such properties. Because of lack of space, a large number of empirical methods of estimating thermochemical data are omitted from the discussion.

The book, as pointed out by the authors, can serve as a good text for chemists as well as chemical engineers.

Practical Knowledge

PROCESS ENGINEERING IN THE FOOD INDUSTRIES. By R. J. Clarke. Philisophical Library, New York, N. Y. 355 pages. $10.

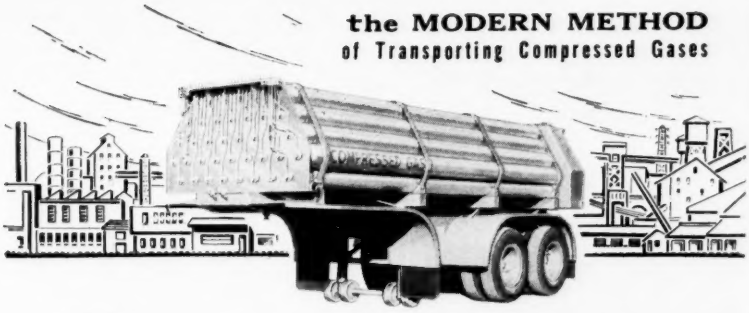
Reviewed by Arthur Gemmill, Senior Associate Editor, Food Engineering magazine, New York, N. Y.

Written specifically for those responsible for management of the plant and for improving its performance, this text is based on the author's practical knowledge of methods and equipment, rather than design principles.

Unit operations are retained for convenience, although the process engineering of foods relates more to physical changes than to chemical reactions.

Each unit operation is treated under three headings: General principles, based on purpose, mechanism, rate factors, methods, and power required; descrip-

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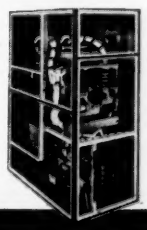
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Six *complete* blending cycles per hour are common. And Sturtevant's special action produces no particle reduction, cleavage or attritional heat – is highly effective yet gentle and safe even with explosives.



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Scoops cascade material as drum rotates. Movement forces material from both ends to middle. Thus blending is 4-way right from start of charging.

Discharging

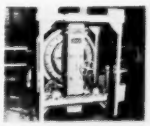
Single gate controls charge, discharge. Blending continues throughout discharge phase. Result is no segregation or flotation — highly intimate, even blends.



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Operation of Sturtevant Blenders is self-cleaning – drum interiors are completely dust-sealed. For inspection of all models, one man simply loosens a few lugs to remove manhole cover – quickly and easily.

Nine standard models with capacities to 900 cu. ft.



10 cu. ft. Sturtevant Blender at U.S. Steel Corp.'s new Applied Research Laboratory (Raw Materials Division) in Monroeville, Pa. This unit handles batches up to 500 lbs. — is ideal for pilot work and small runs.

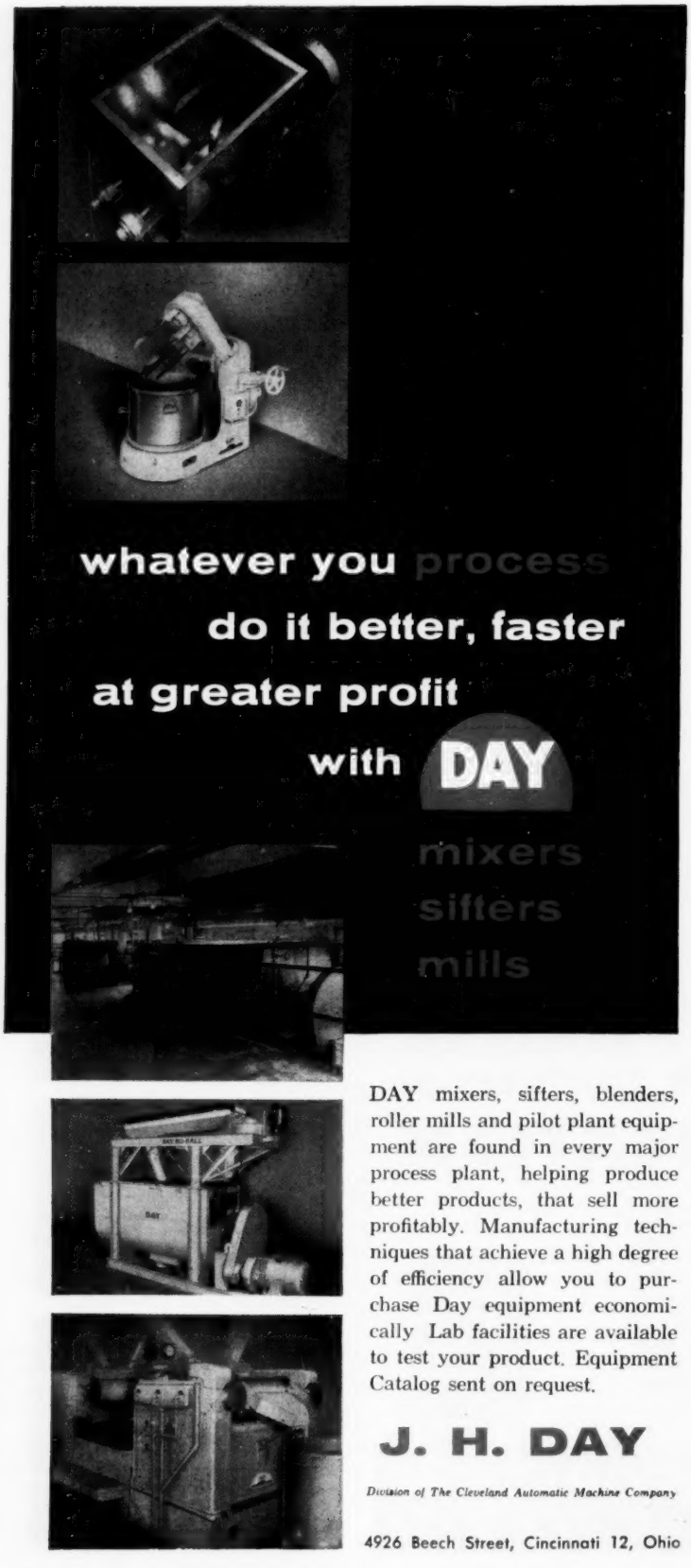


One of four 450 cu. ft. Sturtevant Blenders at Celriver Plant of Celanese Corp. (Rock Hill, N. C.). These large units handle up to 20,000 lbs. batches — have a 9-year record of meeting the most exacting blending requirements.

Fully or semi-automatic, or manually controlled operation

Constructed of carbon steel, stainless steel or Monel metal, Sturtevant Rotary Blenders are engineered to fit each customer's needs – can be supplied with injector sprays and any desired control system.

For more on Sturtevant Blenders, request Bulletin No. 080B. (Bulletins also available on Mixers, Air Separators, Micronizers, Crushers and Grinders.) Write today. STURTEVANT MILL CO., 100 Clayton St., Boston, Mass.



DAY mixers, sifters, blenders, roller mills and pilot plant equipment are found in every major process plant, helping produce better products, that sell more profitably. Manufacturing techniques that achieve a high degree of efficiency allow you to purchase Day equipment economically Lab facilities are available to test your product. Equipment Catalog sent on request.

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tion of equipment, arranged to classify and detail plants in common use in Great Britain; illustrations of equipment.

Subjects covered chapter-wise include: Liquid flow, heat exchange, heat processing methods, liquid filtration, evaporation and distillation, extraction and expression, crystallization, gas flow, drying and dehydration, size separation of solids, adsorption, centrifugal separation, size reduction of solids and liquids, mixing, gas absorption and desorption.

BRIEFLY NOTED

CHEMICAL WASTES, *Vol. 3 of the Manual on Disposal of Refinery Wastes. 76 pp. American Petroleum Institute, 50 W. 50 St., New York 20, N. Y.* $2. Presents recommended practices for utilizing, treating and disposing of chemical wastes from petroleum refineries.

COUNTERFLOW COOLING TOWER PERFORMANCE. *85 pp. Literature Dept., J. F. Pritchard & Co. of California, 4625 Roanoke Parkway, Kansas City 12, Mo.* $3. Gives engineering information for selection and performance of countercurrent cooling towers.

HIGH - TEMPERATURE PROTECTIVE COATINGS FOR MAGNESIUM. *112 pp. By C. R. Fitzgibbon, E. H. Miller and M. A. Glaser. Order PB 131073 from Office of Technical Services, U. S. Dept. of Commerce, Washington 25, D. C.* $3. Discusses three air-drying coating systems for protection of magnesium alloys.

METAL POWDER ASSN., PROCEEDINGS OF 13TH ANNUAL MEETING. Vol. 1—*General Session on Powder Metallurgy; Vol. 2—Ferrites and Electronic Core Session. Metal Powder Assn., 130 W. 42 St., New York 36, N. Y. Vol. 1, $4; Vol. 2, $3.* Vol. 1 covers all phases of powder metallurgy industry, from fundamental theory to trade practices; Vol. 2 covers special problems of ferrites and electronic cores.

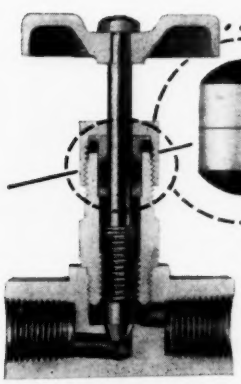
MORE NEW BOOKS

RADIOISOTOPES—A new Tool for Industry. By Sidney Jefferson. Philosophical Library. $4.75.

THE FUTURE SUPPLY OF OIL AND GAS. By Bruce C. Netschert. Johns Hopkins Press. $3.

"...yet we have IMPROVED it"

The Marsh Stainless Steel Needle Valve could have gone right on being the finest in its field... yet we have improved it



...with fabulous "TEFLON" packing

Note the "close-up." The Marsh Marpak packing system, originated in the Marsh Needle Valve, was one of the factors that has enabled it to stand up and work right under pressures up to 10,000 psi.

Now "Teflon" is used in this packing system—the miracle material of almost incredible *toughness, resilience* and *non-adhesive* properties... properties that are not impaired by the most powerful of solvents, acids, or alkalies even at temperatures *up to 500° F.*

Net result: The guaranteed application-range (up to 10,000 psi) is now effective at any temperature up to 500° F. (In other makes, permissible temperature decreases as pressure increases.)

Marsh Marpak Teflon Packing System is standard in Marsh 416 Stainless Steel Needle Throttling Valves. Ask for facts.

MARSH
Needle Valve in 416
stainless steel throughout
Now with "Teflon" Packing

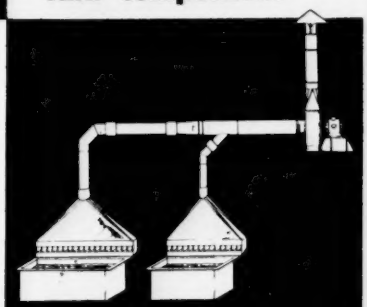
MARSH INSTRUMENT CO. *Sales Affiliate of Jos. P. Marsh Corp.*, **Dept. 24, Skokie, Ill.**
Marsh Instrument and Valve Co. (Canada) Ltd., 8407 103rd St., Edmonton, Alberta
Houston Branch Plant: 1121 Rothwell St., Sect. 15, Houston, Texas

Leakproof

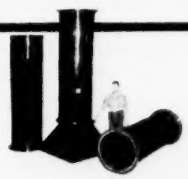
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Write us for a free copy of Bulletin TL-526. Tells how and where you can best use Tygon linings.

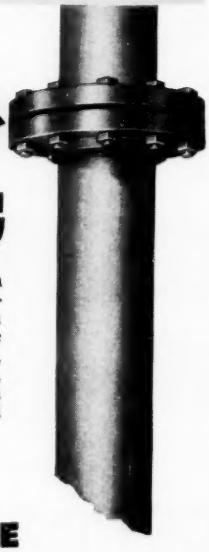
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161-F

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163-F

WRITE FOR BULLETIN G-520R

Plastics and Synthetics Division

U. S. STONEWARE
AKRON 9, OHIO

PEOPLE . . .

MEET YOUR



E. L. (Zeke) Clark

PILOT PLANTS IN PROCESS TECHNOLOGY. PAGE 155.

Consulting engineer E. L. (Zeke) Clark makes his home in Pittsburgh, Pa. In 1914, when he was two years old, his parents migrated from Russia and settled in Boston, Mass. There, he went to elementary school and to the Public Latin School.

After brief study at MIT, Clark entered Northeastern University to concentrate on chemical engineering. He earned his degree in 1937.

First job was with the Commonwealth of Massachusetts as a junior chemist. Assignments included testing water and sewage supplies. Part of his work was at the Lawrence Experiment Station.

In 1940, he joined Stone & Webster as a junior engineer. After several years on the design of power plants, synthetic rubber and chemical facilities, he decided to seek some actual plant experience.

To find it, he headed south to Lake Charles, La. There, he joined Cities Service Refining Corp. as a senior process engineer and took part in the start-up, operation and technical servicing of an oil refinery and a butadiene plant.

Toward the end of 1945, he took on a post with the U. S. Bureau of Mines as a chemical engineering section chief in the synthetic liquid fuels program, later heading the coal hydrogenation section of the Bruceton Laboratories. Then, in 1953, he

AUTHORS

M. A. GIBBONS

was transferred to Washington to assist in program planning of pilot plant activities for the Bureau's synthetic liquid fuels program.

While with the Bureau, Clark was also part time associate professor of chemical engineering at the University of Pittsburgh and, in Washington, lectured on unit operations at Catholic University.

Following a two-year period as director of pilot plant laboratories for Israel Mining & Industries in Haifa, Clark returned to Pittsburgh in 1956 to engage in consultation for the chemical, coal and nuclear industries—especially relating to high pressures, coal processing and pilot plant practices.



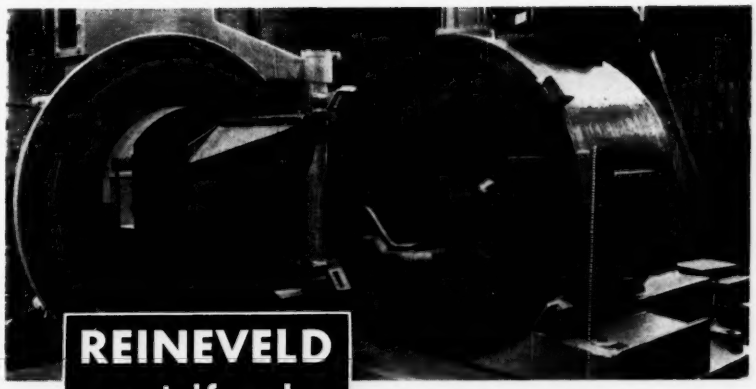
Roy W. Brown

FEATURE REPORT: HIGH-TEMPERATURE NONMETALLICS. PAGE 135.

Roy W. Brown, manager of technical service for Carborundum's refractories division, has a pet hobby which isn't too far afield from his chosen line of work.

Something of a seasoned gourmet: Roy is a self-styled cook, connoisseur of exotic foods and authority on the real "finds" in restaurants.

If you're ever lucky enough to be a guest at the Brown dinner table, you needn't be at all surprised to hear that the main meat



REINEVELD centrifugals

Reineveld 51" Automatic Centrifuge showing easy access to internal parts.

are used extensively for dewatering and washing of crystalline solids, and for separation and clarification of fine amorphous slurries. Effective bowl capacities range from 3 to 325 gallons. Reineveld is one of the world's largest builders of centrifugal equipment—avail yourself of the services and experience of a leader.

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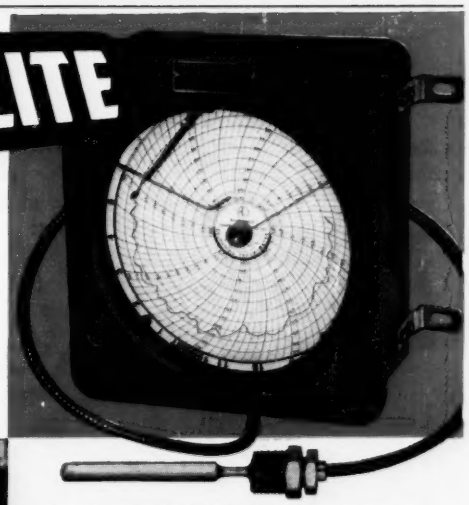
Heyl & Patterson INC.

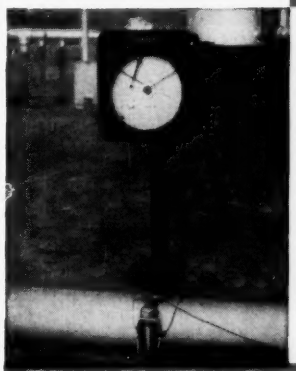
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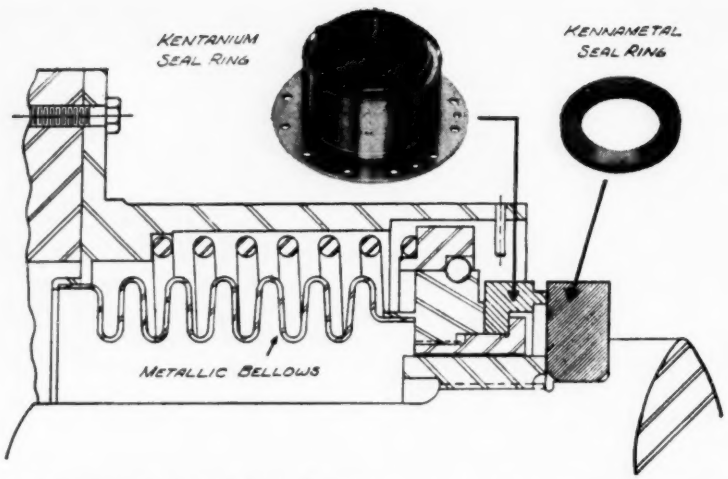




Auto-Lite Model "1000" Temperature Recorder has 6" chart. Various standard ranges from minus 40° F to plus 550° F. Available for wall mounting, portable or portable self contained use. Electric or mechanical chart drive. Choice of 24-hr. or 7-day cycle. Capillary tubing permits remote reading. Priced as low as $49.50. Manufactured to customers' specifications. Send for latest Catalog describing many types of Auto-Lite Recorders and Indicators.

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TEMPERATURE RECORDERS & INDICATORS



KENNAMETAL* Rotary Seal Rings provide substantially zero leakage at mile-a-minute rubbing speeds

At rubbing speeds of 4200 to 5400 ft./min., the hydraulically balanced seal shown above achieves substantially zero gas leakage. Excellent wear characteristics of the Kennametal and Kentanium* Seal Rings featured in this design make possible unlubricated dry rubbing at peak speeds.

Stein Seal Company, Philadelphia, Pa., solved major sealing problems on many applications by using Kennametal and Kentanium parts in their hydraulic balanced seal design such as illustrated above. By using rings made of these hard carbide, wear-resistant compositions, it is possible to operate with higher spring forces and in much higher temperatures than when rings of conventional sealing materials are used.

The outstanding physical properties of Kennametal compositions have provided many more answers to rotary seal ring problems in the fields of petroleum refining and transportation, high-pressure high-temperature chemical production and nuclear power. For example, K501, a platinum-bonded carbide, is being used to confine liquid oxygen and red fuming nitric acid. Results are reported by the customer to be "far superior to any previously-used materials, with no indication of face wear."

Various grades of Kennametal compositions hold economical answers to *your* need for high YME, low thermal expansion, high resistance to abrasion, erosion, corrosion, impact and pressures. For positive sealing, with little or no maintenance, mating surfaces of Kennametal Seal Rings can be lapped to a flatness less than two light bands, with a surface finish better than two microinch.

For more information, just outline your problem and send it to KENNAMETAL INC., Latrobe, Pa.

*Trademark

3130

INDUSTRY AND
KENNAMETAL
...Partners in Progress

AUTHORS . . .

course has been soaking in wine or some tangy sauce for the past few days—at least. And, if you ever want advice on a good place to eat in New York, Mexico or anywhere in the Southwest, you'll be sure of a good tip if you check with the Brown household.

But Roy's know-how isn't limited to kilns—culinary or industrial. During the past seven years, he has become thoroughly versed in the workings of the chemical process industries—first, through a Carborundum post in the Gulf Area. There, his job was to cooperate with process and metallurgical firms in the application of super refractories. Later, as manager of technical service—a post he still holds, for the refractories division—his familiarity with the process industries took on a third dimension. In the course of his work, Roy helped firms with their particular problems and frequently gave talks to groups of engineers.

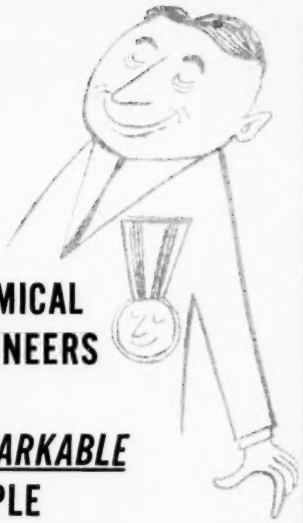
The more contact he had with engineers in the chemical process industries, the more he realized how woefully deficient they were in using high-temperature materials to good advantage. Roy's hope of resurrecting these materials from their step-sister's role in the CPI resulted in the current report.

Brown originally started working for Carborundum a little over ten years ago. In his first assignment, he conducted special research work and later was also involved in the engineering and development of new products.

Educational background includes a bachelor of science degree in ceramic engineering from Rutgers University and special work in the field at Lafayette College.

During World War II, Roy served three years with the Infantry. After he was discharged from the Army, he joined the faculty of the ceramic engineering department of Rutgers University.

The Browns live in Little Silver, N. J., with their six children. In addition to his family and the interests we've already cited, Roy enjoys bridge, any number of sports and amateur painting.



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They devise means of making products that vary all the way from tranquilizers to jet fuels, from cosmetics to fertilizers. They develop and plan the production processes; design, build, operate, maintain and manage the nearly 11,000 plants of the United States' Chemical Process Industries.

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Chemical Engineering

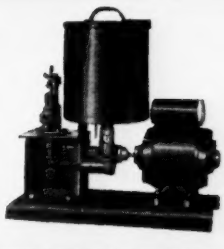
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MANZEL



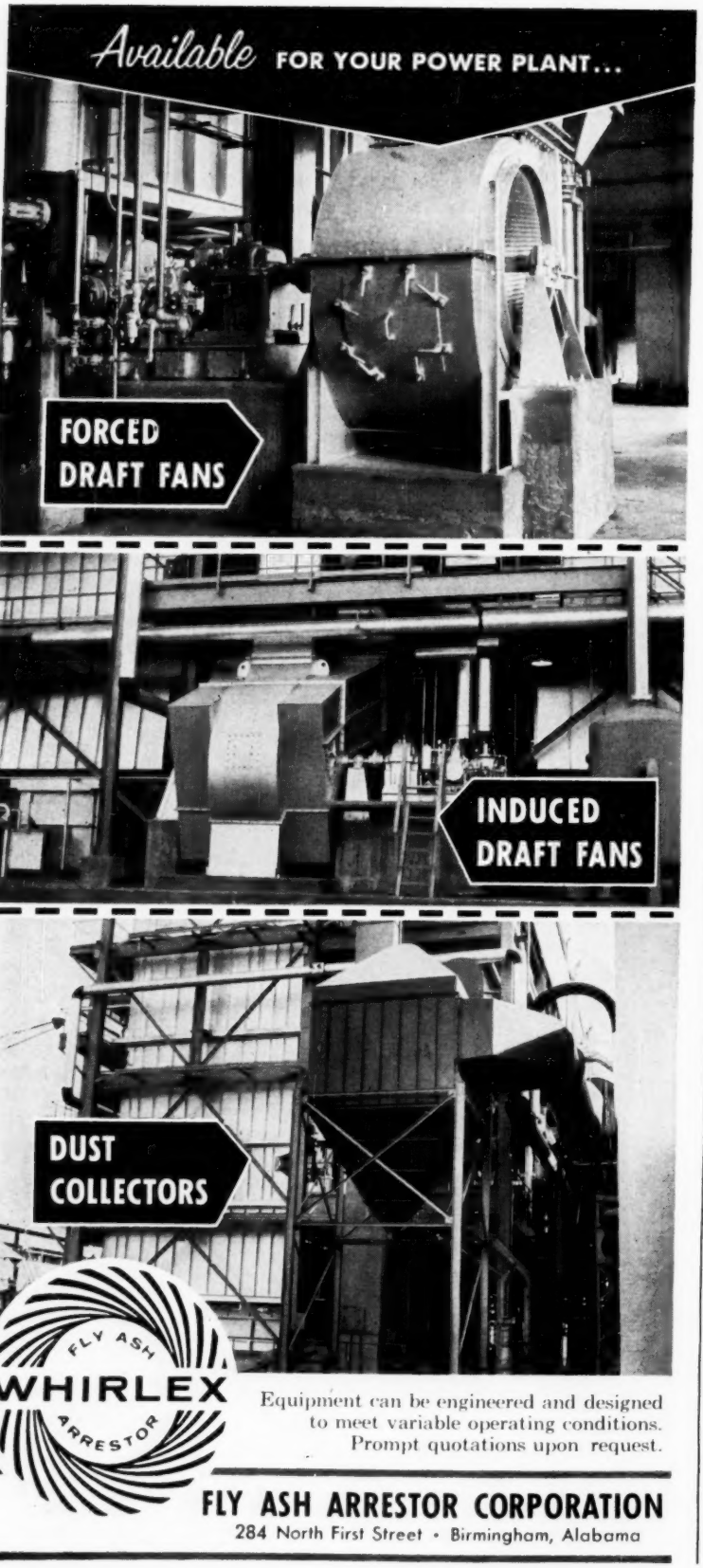


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PEOPLE . . .

LETTERS:



Pro: Effective Meetings

Sir:

After seeing how well you handled my recent article, "How to Run an Effective Meeting" (Jan. 27, 1958, pp. 157-160), we have decided to use it in our local foreman training program. We feel that it would have a nice effect if we were to reproduce the article and give a copy to each foreman.

WALTER L. KNIGHTEN
Gulf Oil Corp.
Port Arthur, Tex.

Con: Blast Furnace Scrap

Sir:

Reference is made to your January 27 issue, pp. 118-9, where your Report author, L. W. Coffer, states that scrap is necessary for blast furnace operation.

Scrap is not necessary in the burden for operation of a blast furnace. To the contrary, you will probably find a higher percentage of blast furnaces operating without any scrap at all in the burden.

In cases where scrap is used in the burden, you will find that the scrap is a small percent of the total burden. You will also find that blast-furnace scrap grades are generally lower-priced than

PRO & CON

C. H. CHILTON

grades used in steel-making furnaces or cupolas.

R. H. RIDGWAY, JR.
Ordnance Ammunition Command
Joliet, Ill.

► *Author and editor slipped up here; we should have said "steel furnace" instead of "blast furnace."*—ED.

Perforation, Pro & Con

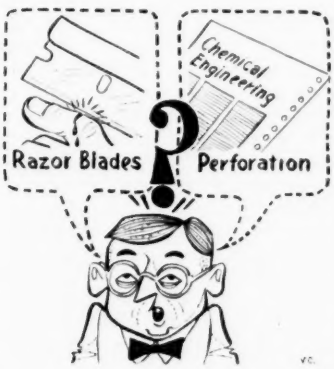
Sir:

There are those of us who like to keep *Chemical Engineering* intact for a year or so to lend to students, etc. I vote against perforated pages.

For those who prefer to tear pages, may I suggest a single-edge razor blade kept in the top desk drawer? It does a neat job every time.

If you shave with an electric razor, borrow a blade from your secretary.

BILLINGS BROWN
Brigham Young University
Provo, Utah



Sir:

Had just finished cutting my finger when I ran across the letter from Mr. Ellison (Jan. 27, 1958, p. 171) on the subject of perforated pages.

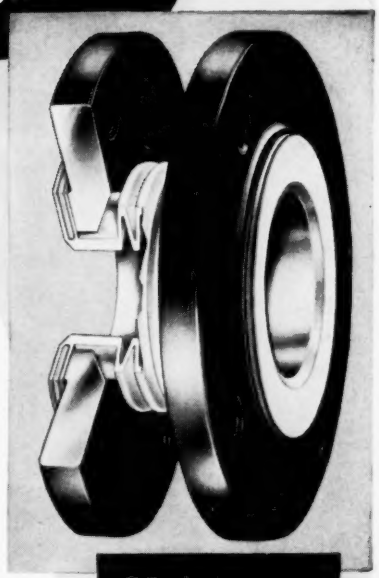
Enter my name as a subscriber in favor of perforated pages.

D. R. DRUVA
Stearns-Roger Mfg. Co.
Denver, Colo.

► *Within the first few days after the January 27 issue was mailed*

Here's The Plain Truth About CHEMLON® Flexible Pipe Connectors

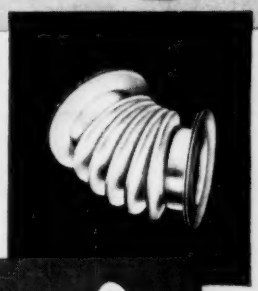
*"John Crane" fabricated from DuPont Teflon



When it is a question of chemical piping—where you need anti-corrosive protection, plus long life—Chemlon Connectors best meet the need. They are fabricated from the most chemically resistant material available, DuPont Teflon. The most destructive acids, corrosives and solvents have no deteriorating affect*

Other important advantages are their long service-life, extreme flexing ability and wide temperature range from −65°F. to +350°F.

Chemlon flexible pipe connectors offer a definite plus value construction-wise. 1) They are made from Teflon specially fabricated for high and uniform density. 2) An exclusive manufacturing method assures uniform wall thickness throughout the convoluted area. 3) They are formed at full free length to reduce residual and working strain to an absolute minimum.



Vibration and Misalignment

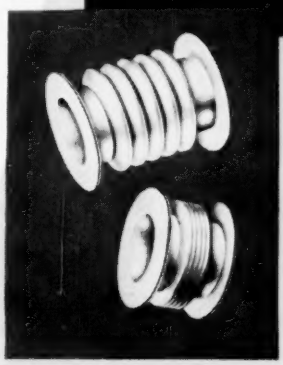


—severest vibration and misalignment conditions, such as pump to agitator or mixer to tank, will cause little deterioration or fatigue. Also, the Chemlon Flexible Pipe Connector serves as an acoustical as well as a mechanical dampener.

Expansion and Contraction



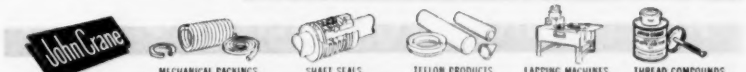
—continuous flexing over a wide range of temperature conditions has little affect on Chemlon Flexible Pipe Connectors.



Chemlon Flexible Pipe Connectors handle pressures to 75 psi., dependent on size. They can be supplied to fit any pipe size from ½" to 12" and are available with companion flanges conforming to American Standard Class 125 Cast-Iron Pipe Flange specifications.

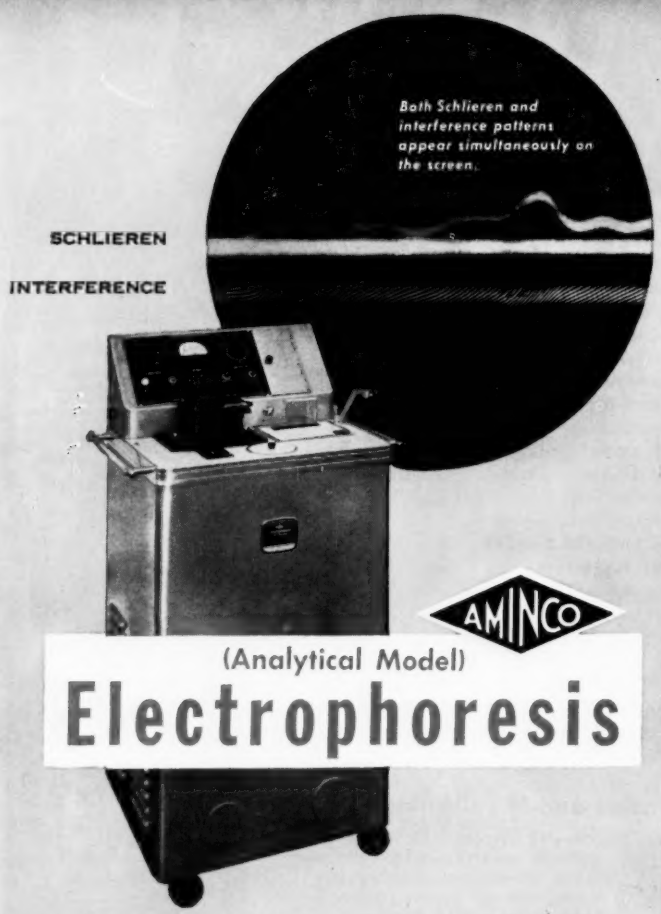
Request full information. Crane Packing Co., 6451 Oakton St., Morton Grove, Ill., (Chicago Suburb). *In Canada: Crane Packing Co., Ltd., Hamilton, Ont.*

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Electrophoresis

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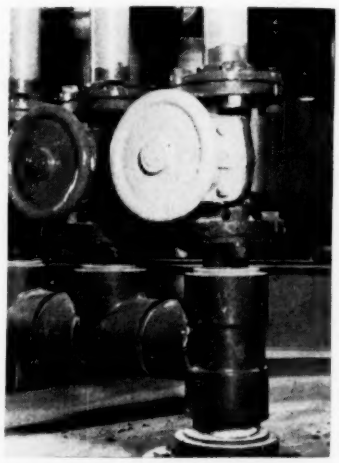
Send for **Bulletin 2287-C**

AMERICAN INSTRUMENT CO., INC.

8030 GEORGIA AVE., SILVER SPRING, MARYLAND

PRO & CON . . .

we received a number of letters from readers on this subject. As shown in the typical comments above, opinion is divided. What do you think? Let us have your reasons why you favor or do not favor perforated pages. You can be a big help in the study we're now making.—ED.



What Pressures in Plastics?

Sir:

We read with considerable interest the article, "Plastics Vie With Metals," in your November issue (pp. 296-304).

We were rather surprised at the maximum working pressures for rigid PVC piping at 75 F., as well as the temperature conversion factors. These figures are very much higher than those to which we have normally worked. We wonder whether any allowance has been made for safety factor.

We have worked to the German specification DIN. 8062. Recently we obtained a technical bulletin from an Italian firm in Milan, and their working pressures are about halfway between yours and the Germans.

We have noted in the technical literature large differences in recommended working pressures

Your comments and opinions are important. Send them to Editor, Chemical Engineering, 330 West 42nd St., New York 36, N. Y. They'll be welcomed.

for plastic piping. Since we should naturally like to be able to recommend the most economical designs to our clients, we are most anxious to understand these differences.

T. R. GRANTHAM
Anti-Corrosive Pipe & Lining Co.
Box Hill, Victoria, Australia

Sir:

Our maximum working pressures at 75 F. and the temperature conversion factors for rigid PVC piping are a consolidation of practices recommended by U. S. manufacturers. They are, in general, based on an allowable stress 20% of the short-time tensile strength, taking into account limited information on creep properties of the material.

The variations from European practices for maximum working pressure can be attributed to several factors. One might be the use of resins and extrusion compounds which vary in their resistance to stress, as a function of temperature or time, or both. Another factor might be the degree of confidence in the stress data which are available for the compounds employed.

JAMES P. KELLEHER
Carpenter Steel Co.
Union, N. J.

Con: Wooden Duct Systems

Sir:

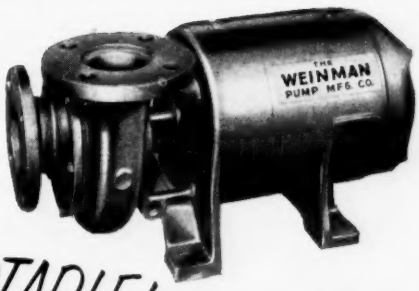
In your Feb. 10, 1958, issue (p. 158), there is a description of a duct exhaust system made of plywood covered with an epoxy-resin-impregnated fiber.

In this connection, your readers should be interested in the following excerpt from *Factory Mutual Record*, November 1955, describing two fires involving wooden ducts:

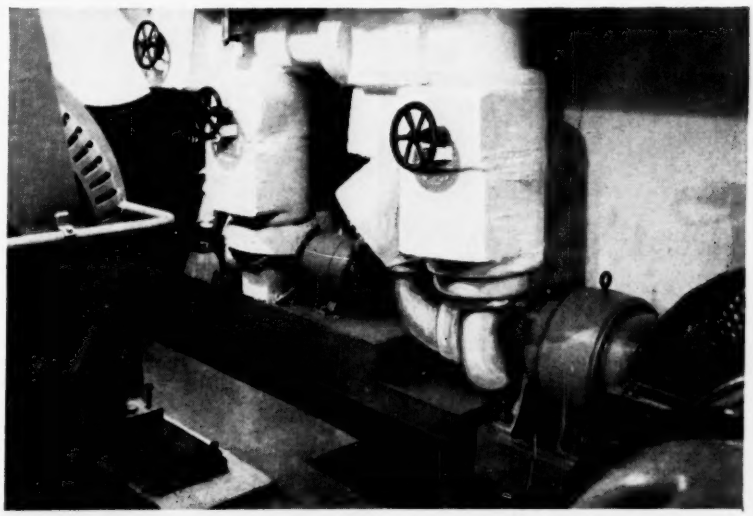
"*Fire No. 1*—Corrosive, toxic fumes from chemical operations were drawn out through individual ducts into other large wooden ducts, 15 by 20 ft. in cross section, extending more than 500 ft. over the roof to a high brick fume stack. A cutting torch being used on a machine ignited oily deposits. Flames were drawn into one of the ducts. Fire spread rapidly through the entire system, feeding on combustible corrosion-resistant linings and on the wooden construction itself. Heat and smoke

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Adaptable . . . Versatile . . . Simple . . . Compact . . . Economical. Weinman General Service Unipumps are truly **all-purpose**, general service pumps.

Completely adaptable, Weinman General Service Unipumps operate efficiently and dependably in any position. Horizontally, vertically, on floors or walls.

Extreme unit compactness makes Weinman General Service Unipumps ideal for installations in limited space area.

Available in a range of ½ to 50 horsepower, Weinman General Service Unipumps can be purchased with either enclosed or open type impellers, in capacities to 1700 gpm, with heads to 260 feet!

Ask your Weinman Pump Specialist for all the facts about economical, versatile Weinman General Service Unipumps. He'll answer all your questions. You'll find his name listed in the yellow pages of your telephone book.

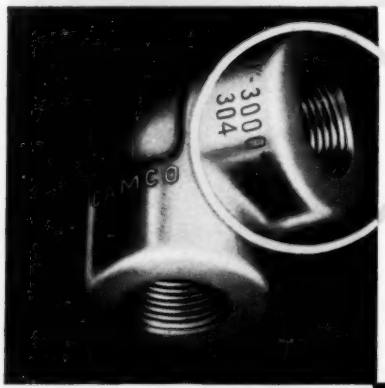


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Gentlemen: Please send CE

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CAMCO PRODUCTS, INC. North Haven, Conn.

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prevented close approach to access openings. Over 1,000 ft. of ductwork and eight large fans were destroyed, stopping production completely. It took ten days to resume even partial production. The damage, plus use and occupancy loss, amounted to several million dollars.

"Fire No. 2—Sparks from exhaust stacks from gas-fired heaters ignited a nearby air intake duct of fiberboard wood-frame construction, 7 by 12 ft. in cross section and nearly 70 ft. long, located above the roof. Though discovered and attacked promptly, the fire spread so rapidly that it involved the entire duct and soon destroyed it completely. Smooth-surfaced roofing, the building roof itself and other exhaust systems were severely damaged. Three days' production was lost even to make temporary repairs."

Ducts such as described in your article should never be installed unless they are equipped with automatic internal fire protection.

W. H. DOYLE
Factory Insurance Assn.
Hartford, Conn.

Pro: Batch Processing Costs

Sir:

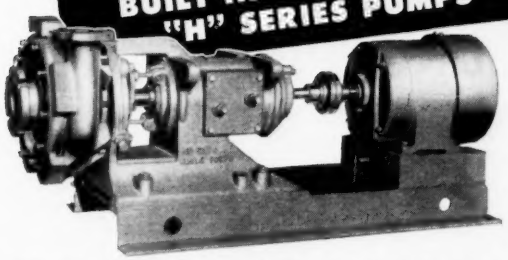
Small-plant management in the chemical specialty industry —utilizing batch processes with kettles, tanks, mixers and packaging equipment—needs help and guidance in the field of cost accounting.

For example, we have been searching for material to help us in the installation of a combined general and standard cost accounting system that will give us accurate unit costs. We haven't as yet located much on this subject, except in textbooks mainly pointed toward job-lot machine production.

I believe that this would be a fertile field for your magazine. Most of your stuff in the field of engineering economics deals with continuous processes and acres of plant facilities. We need stuff the small man can utilize as is or adapt to his particular needs.

HERMAN J. HINDMAN
Hindman Products
Morgantown, W. Va.

"INTESTINAL FORTITUDE" BUILT INTO NEW NAGLE "H" SERIES PUMPS



The new "H" Series of Nagle Pumps, designed exclusively for the abusive pumping jobs of industry, is simplicity itself. Three types of water ends available to meet specific conditions, type "HF", "HC" and "HR" (shown). Various alloys used for water-end members depending upon corrosive, abrasive or high temperature conditions involved. Water-end can be rotated to any one of four discharge positions. Slippage seal adjustment takes only moments using a common wrench. Packing gland is readily accessible. Radial adjustment of shaft to insure concentricity through stuffing box is a matter of seconds. Various types of impellers available. Impellers readily accessible. Oil or grease lubrication is optional. Sizes from 1" to 10". Heads up to 250' or more. Capacities to 4,000 G.P.M. A "must" for those tough applications where ordinary pumps fail. Send for Bulletin "H"

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above or below ground



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WATER RESERVOIRS ELEVATED TANKS STANDPIPES

and STEEL PLATE FABRICATION

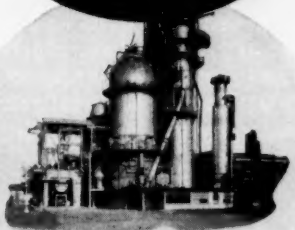


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Produces Finished Product in One Operation



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*Trademark—Patent Pending

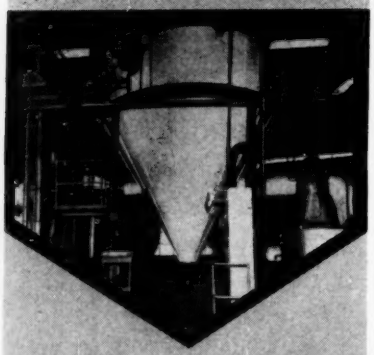
A flexible compact unit that combines a powerful disperser head with a rugged diamond-shaped agitator to produce finished homogeneous batches without further processing—for most chemicals, inks, plastics, pharmaceuticals, cosmetics, paints, and industrial finishes.

Modern design gives high degree of shear, kinetic impingement, and complete mulling action for better wetting, improved dispersion, and uniform blending. Small size laboratory models available.

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To chemical processors and manufacturers, Nerco-Niro offers an economical, time-saving large tonnage custom spray drying service at its pilot plant at Netcong, New Jersey. Large or small scale spray drying tests can also be made under expert engineering supervision. Drying equipment includes a 32" diam. Laboratory Unit; a 7'6" diam. Pilot Size Unit, and a 16'0" diameter Commercial Size Unit, all of stainless steel throughout.

Nerco-Niro has the most fully equipped plant of its kind in the U.S. If you have a difficult-to-dry chemical product, it will pay you to investigate the Nerco-Niro "Gentle-ized" Spray Drying. Write today for Bulletin #232.

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PEOPLE...

NAMES IN THE NEWS

M. A. GIBBONS

EAVESDROPPING



Dr. Piero Modigliani, executive director of research, Modiglass Fibers, Inc., chats with reporters at opening of research and development center.

*"Is creative research really necessary in a product development center?"**

"We all know that a product, any product, is only the crystallization of an idea; if the idea is sound, the product is bound to be good.

"We all know that a machine or a process is only an idea in action; if the idea is sound it will work. I don't believe in inspiration nor in the working of the subconscious in creative research. We all are both conscious and unconscious all the time while we live and work. Nothing new was ever produced by reasoning alone; but without reasoning everything remains asleep like seeds in winter.

"Still, there is no room for sound, matter-of-fact individuals in creative research. It might seem (that) this is a contradiction: How can a man without a sound judgment produce the sound idea necessary for the good product?

"Here enters the engineer; the necessary link between the scientist or scientician, full of ideas, and the finished product of the machine that works.

"We certainly need the cushion of good engineering between creative research and product development, and also between product development and actual production. . . .

"The mind is the world of a research community and the individual who works in a research project knows that if he fails to participate in what others are doing, he is left alone. So a good research project must be designed to arouse a sense of membership to a whole that cannot be split up in partial functions. While in production, men are merged with their functions; on the other hand in research men must express themselves as individuals.

"In a product development center we need the man; who applies the methods and the results of particular sciences in his daily work; and if his creative research is successful

* Dr. Piero Modigliani spoke at the dedication ceremonies of Nicolet Industries, Inc., and Modiglass Fibers, Inc., new executive offices and research and development center at Florham Park, N. J., on March 14, 1958.

PUMP

Liquids Gases Slurries } **WITHOUT CORROSION or CONTAMINATION**



Wavelike Motion of Steel Finger

Forces Material Through Tubing



Capacities 0.2 cc. per min. to 4.5 G.P.M.

Prices range from ..... $60.00 to $550.00 depending on size and accessories

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VALVE WARMER

In previous issues of this journal—June 1957 and March 24th, 1958—we told about this modern Valve Warmer and showed other views. It is a CURVED



DEAN THERMO-PANEL COIL

It "surrounds" and heats or cools the valve, as needed. Result: at much lower cost Chemical Engineers can now warm viscous fluids and liquids sufficiently to give the desired flow at any time.

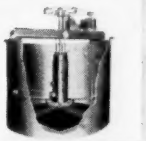
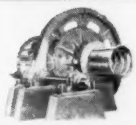
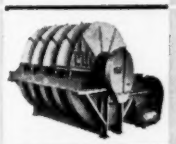
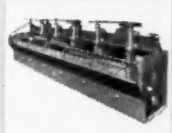
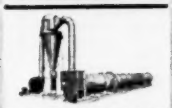
ASK FOR DATA

Complete information on this Valve Warmer and Cooler is given in Form V-2. Bulletin 355 is a treatise on the Dean Thermo-Panel Coil which TAKES THE PLACE of old-style pipe coils. Bulletin 258 gives design and price data.

Backed by 20 Years of Panel Coil Manufacturing.

DEAN THERMO-PANEL COIL DIVISION
DEAN PRODUCTS, INC. 612 Franklin Ave
BROOKLYN 38, N. Y. Tel. Sterling 9-5400

DENVER PROCESS EQUIPMENT

DENVER (patented) **SUPER AGITATORS and MIXERS**		3'x 3' to 20'x 20'	Patented standpipe around propeller shaft assures positive agitation and circulation. Patented wearing plate prevents sand-up on shut-down. Heavy duty as well as acid-proof construction is available in both open-type, air lift and Super Agitator models. Please write for Bulletin No. A2-B4.
DENVER Steel-Head **BALL MILL**		3'x 2' to 8'x 20'	A Denver Steel-Head Ball Mill will suit your particular need. Five types of discharge trunnions. All-steel construction. Low initial cost due to quantity production. Quick delivery. Laboratory and pilot plant mills also available. Please write for Bulletin No. B2-B13.
DENVER Automatic **SAMPLERS**		16" to 60" Cutter Travel	Heavy duty units, extra rigid track and ball-bearing wheels assure positive travel and timing of sample cutter. Available in stainless steel for acid and corrosive service. Wet and dry cutters. Central Control Panel for multiple samplers. Bulletin No. S1-B4.
DENVER Forced-Feed **JAW CRUSHER**		2¼"x 3½' to 36"x 48"	Cast Steel Frame, manganese jaw and cheek plates. Large diameter shafts reduce shaft deflection and thus increase life of heavy-duty, oversize roller bearings in bumper. Setting easily controlled. Please write for Bulletin No. C12-B12.
DENVER Wet Reagent **FEEDER**		0 cc to 2000 cc	Accurately meters minute quantities of liquid from 0 cc to 2000 cc per minute. Float valve in tank permits connection of feeder to bulk storage device. Handwheel adjustment to control amount of liquid is simple and accurate. Used in multiples for higher capacities. Please write for Bulletin No. F6-B9.
DENVER Disc **FILTER**		1 Disc, 2' to 12 Disc, 9'	Special, patented design of segments in Denver Disc Filters use both gravity and vacuum to give a drier filter cake. Drainage is complete and positive, with no blow-back. Simple, low-cost, dependable construction. Quick delivery. Also Drum and Pan Fillers. Please write for Bulletin No. FG-B1.
DENVER "Sub-A" **FLOTATION**		Laboratory and Commercial	Flotation is the selective separation of particles from each other in a liquid pulp by means of air bubbles. More large plants are installing Denver "Sub-A's" for their entire flotation job, because they give maximum recovery at a low cost per ton. Dependable, low-cost, simplified continuous operation. Please write for Bulletin No. F10-B81.
DENVER Wilfley Concentration **TABLES**		5 to 150 T/24 Hrs.	A mechanically operated, longitudinally reciprocating table consisting of a deck having a plane surface partly riffled and a tilting device. It separates materials into bands and handles the coarsest sands with excellent results. Ideal for separation of groups of particles having a similar range of specific gravities. Write for Bulletin No. T1-B3.
DENVER LABORATORY EQUIPMENT		Batch or Continuous	Batch and continuous test models of Crushers, Screens, Ball Mills, Pulverizers, Rod Mills, Classifiers, Agitators and Mixers, Pulp Distributors, Feeders, Flotation Machines, Pumps, Thickeners, Filters, Dryers, Tables, Samplers. Results obtained on Denver Laboratory Equipment can be duplicated by commercial machines. Please write for Bulletin No. LG3-B10.
DENVER Standard **DRYERS**		2'x 15' to 5'x 40' and larger	Available in several types: Direct Heat, Indirect Heat, and Steam Tube. Let DECO Engineers solve your drying problem. No dryer problem too small or too large. Please write for Bulletin No. D4-B2.

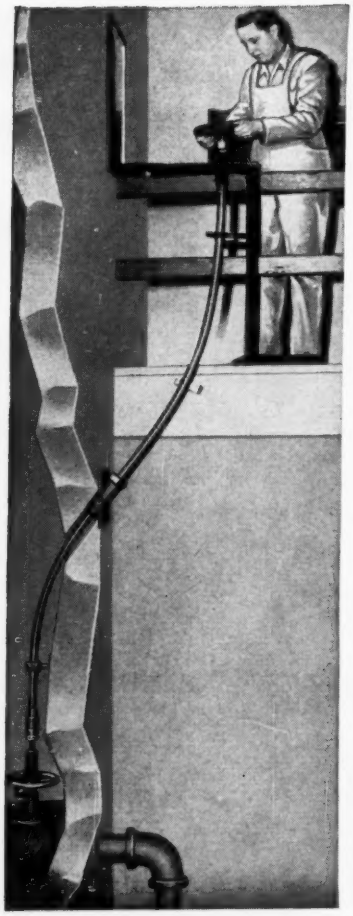
"The firm that makes its friends happier, healthier and wealthier"

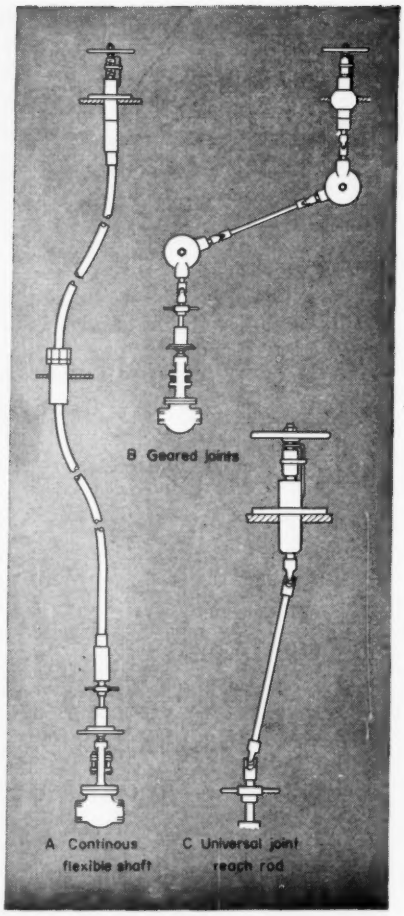
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See Our New Catalog Starting on Page 647 CEC





Typical station arrangements

Remote control for valves

In recent years, increasing numbers of manual remote controls have been installed in industrial power plants and on nuclear reactors. These systems are popular because they eliminate a great deal of hazardous climbing and permit relatively inexpensive control of a number of widely scattered valves.

Stow Manufacturing Co. makes a complete line of these controls, including: flexible shafting, universal joints and geared joints. These controls also include standard remote stations, intermediate connections and valve couplings for both flexible shafting and reach rods.

Typical installations of this equipment are shown above. Sketch "A" shows a flexible shaft that can be used up to 100 ft. in length and is available in sizes up to 1-5/8" diameter. Sketch "B" is an installation using geared joints that operate in any angle through 340°.

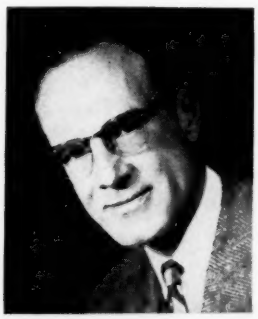
For complete design data on all sizes of standard flexible shafts, geared joints and terminals, write for Design Manual 553.

STOW MANUFACTURING CO.
121 Shear Street, Binghamton, N. Y.

he provides the best gifts for our future.

"With the technological revolution now under way, our economy is not orbiting any more around the old problems of production, distribution and consumption of goods, but on the creation of new products and processes.

". . . Creative research, besides its practical function to help in the development of new products and machines has also an important social function; to give those who are actively engaged in it the opportunity to express themselves and so to be happy and healthy. To mature without getting old is the great gift of any creative activity. . . ."



Herbert W. Beck

CIBA Co. has announced the appointment of Herbert W. Beck as sales supervisor for the pulp and paper industry. Beck, formerly assistant to CIBA's general sales manager, serving the textile, paper and leather trades, has had more than 20 years experience in dye and chemical sales to paper-making industries in the U. S.

Before joining CIBA in 1955 he worked first, in production of dyes and chemical intermediates; later, in chemical sales with National Aniline Division, Allied Chemical and Dye Corp. For a time he was manager of National Aniline's Portland, Ore., office. Beck has also served as a sales representative for paper-making equipment.

Victor T. Mavity, Jr. has joined the Ethyl Corp. research laboratories in Detroit as a technical analyst-writer in the information services group.

Before joining Ethyl, Mavity was associated with Ashland Oil and Refining Co., Lago Oil and Transport Co., Esso Standard Oil Co.

Dewey F. Barich, now assistant manager of educational affairs at Ford Motor Co., will assume the presidency of Detroit Institute of Technology on May 1. Barich succeeds DuVal J. Terpeney, who has been acting president while trustees were interviewing candidates for the presidency.

Thomas H. Chilton, technical director of Du Pont's development engineering division for the past 11 years, has been named technical adviser to the company's engineering department. In the development engineering division, **Charles E. Daniels** succeeds Chilton as technical director; **Charles M. Cooper** is named an assistant division director in charge of the engineering research laboratory; **Harcourt C. Vernon** becomes director of the engineering research laboratory; **Roy A. Kinckiner,** deputy director of the laboratory.



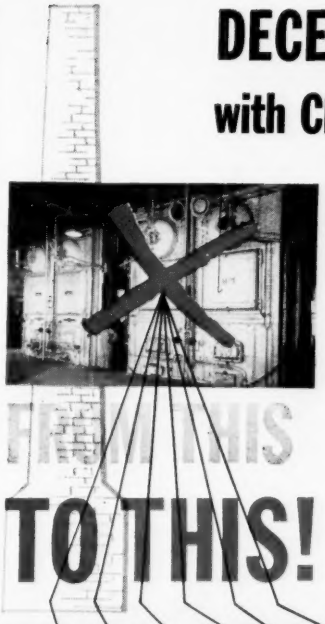
Paul E. Huber

Paul E. Huber is now production manager of Catalysts and Chemicals, Inc., Louisville, Ky.

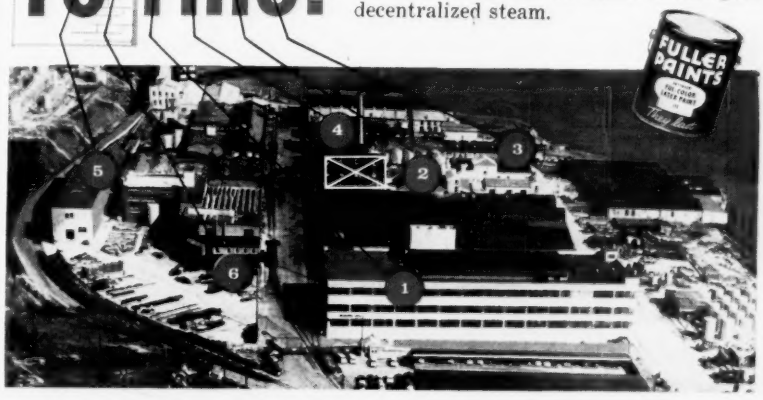
A chemical engineering graduate of the Speed Scientific School, University of Louisville, Huber started his engineering career with Cohart Refractories as a sales engineer and technical service representative. He later joined Houdaille-Hershey Corp. where he held the position of production superintendent, han-

DECENTRALIZED STEAM

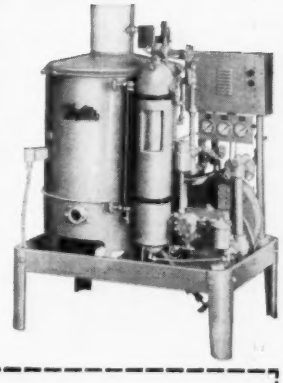
with Clayton Steam Generators Costs Less!



When W. P. Fuller was faced with a large boiler repair bill, plus replacement and possible extension of transmission lines, they looked into decentralized steam... using Clayton Steam Generators. Under the proposed Clayton decentralized steam plan, six Claytons replaced the old boiler room... each one located near the *steam job required.* Considerably more usable steam is now produced at less cost! Decentralized steam expensive to install? Not at all! The entire installation expenditure was less than the cost alone of installing new transmission lines! Investigate decentralized steam.



Buying Clayton Steam Generators is just smart business! These steam units produce more steam at less cost in only one-fourth the space occupied by ordinary steam boilers. They cost less to install too... no stacks to erect, no walls to knock out, lower rigging expense and lower hauling costs... and you can put them practically anywhere! The secret of Clayton's higher efficiency is *controlled circulation* and balanced feed, a principle of using a continuous single pass tube... thus, they are more reliable and easier to operate, maintain. From a cold start, Claytons produce steam in 3 minutes... and all day they produce only steam needed—instantaneously. Let a Clayton representative give you the complete facts.





Clayton MANUFACTURING COMPANY

Sirs:
Please send us more information on Clayton Steam Generators.

Name_____

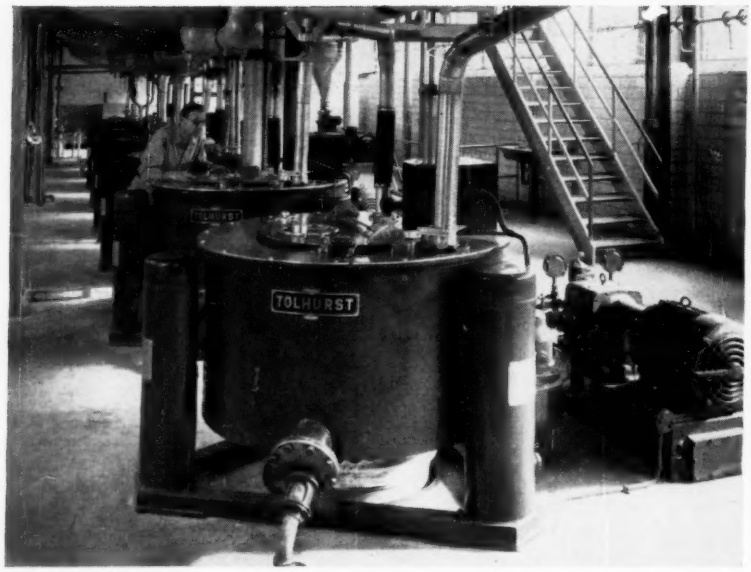
Company_____

Address_____

City_____ Zone____ State_____

We use steam for_____

Send to: **Clayton Manufacturing Company**
409 N. Temple City Blvd.
El Monte, California



Labor savings will pay for these 6 new BATCH-MASTERS® in less than 2 years

Nutley, N. J. — In expanding its production facilities for Gantrisin, one of their sulfa group pharmaceuticals, Hoffmann-LaRoche, Inc., had the option of selecting nine 48″ conventional centrifugals or six 48″ Tolhurst Batch-Master® machines.

After considering that only one man is required to tend each two "Batch-Masters," while four men are needed for every three conventional units, the manufacturer decided on the former machines. The resulting 75% labor savings will offset the total cost of the new machines in approximately 18 months.

The "Batch-Master's" fast bottom discharge and hydraulic unloading make the difference in labor requirements and in batch processing cycle time.

FOR MORE COMPLETE DATA, SEE TOLHURST'S SECTION IN CHEMICAL ENGINEERING CATALOG or write

Tolhurst CENTRIFUGALS

A DIVISION OF

American Machine and Metals, Inc.

Dept. CET-458, EAST MOLINE, ILLINOIS

SPECIALISTS IN LIQUID-SOLIDS SEPARATION

dling specialized production of process equipment for the A. E. C.

For the last 14 years Huber has been active in catalyst research and development. More recently he was catalyst production manager with Girdler Co.



Keith R. Cranker

Keith R. Cranker is the new director of research and development for Plumb Chemical Corp., manufacturer of Fibercore molding compounds.

Cranker has been engaged in the plastics and rubber fields for the past 14 years. Before joining Plumb, he was assistant manager, technical service department, Thiokol Chemical Corp.

Victor J. Carnell, formerly supervisor — operations department, Pennsylvania division of Esso Standard Oil Co. in Philadelphia, has been appointed Midwest manager—sales engineer of Ever-Tite Coupling Co. Carnell will make his headquarters at 2107 Carew Tower, Cincinnati, Ohio.

David M. Kyllonen, resident engineer for Callery Chemical Co. at Los Angeles, Calif., has been transferred to the Muskogee, Okla., division as technical manager.

Robert G. Mispley has been appointed assistant product manager, Crown Zellerbach Corp. headquarters manufacturing department, San Francisco. Previously he was supervisor of product quality and development, Camas, Wash., paper mill and converting plant.



Manley T. Mallard

Appointment of Manley T. Mallard as marketing specialist in the petrochemical field has been announced by Ansonia Wire & Cable Co., in line with the company's plans for diversification.

Mallard was originally employed by DuPont as a chemist on rubberized fabrics, heavy chemicals and explosives. From 1930 to 1943 he was in research and development on rubber and plastic insulations for wire and cable at General Electric Co. in Bridgeport, Conn. Subsequently he was employed as a technical service representative on synthetic rubbers for Hycar Chemical Co., Akron, Ohio.

Prior to joining Ansonia in 1956 (as assistant plant superintendent and later as sales engineer), Mallard was assistant plant manager and director of research for Cornish-Rutland Co., maker of wired assemblies and electrical wiring harnesses and parts.

Ray St. Onge has been appointed advertising and sales promotion manager for Beckman Systems Division.

Ray L. Hobbs has been named chief engineer of the Best Fertilizers Co., Oakland, Calif. He will be in charge of all maintenance and new construction engineering in the present plant at Lathrop, Calif., as well as in the new anhydrous ammonia plant now being built.

P. C. Spencer, president of Sinclair Oil Corp., New York, has been appointed treasurer of the American Petroleum Institute. He succeeds B. B. Jennings of Socony Mobil Oil

Niagara

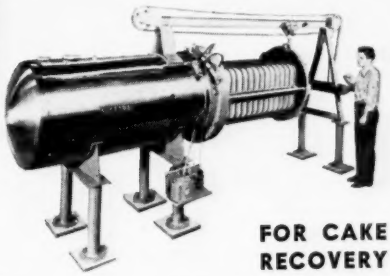
the most dependable name in

PRESSURE FILTERS



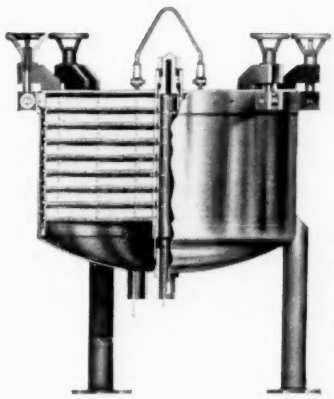
FOR LIQUID CLARIFICATION

Niagara vertical tank models are available in sizes up to 1000 sq. ft. Automatic cake discharge optional.



FOR CAKE RECOVERY

Niagara horizontal tank filters are designed for easy solids removal with capacities up to 250 cu. ft.



FOR SMALL BATCH OPERATIONS AND POLISHING

Niagara Batch-Miser® horizontal plate filters can be used with all types of filter media. Sizes 7.4 sq. ft. to over 200 sq. ft. in a single unit.

Our field engineers can provide you with an accurate and efficient appraisal of your filtration problem and a prompt recommendation of the filtration equipment best suited to your processing needs. Niagara's laboratories and field testing equipment are at your service. See our pages in Chemical Engineering Catalog.

FREE! NEW FILTER AREA CALCULATOR

Determines required filter area on basis of BOTH the *filtration rate* and the *cake capacity*. Write *today!*



Niagara FILTERS

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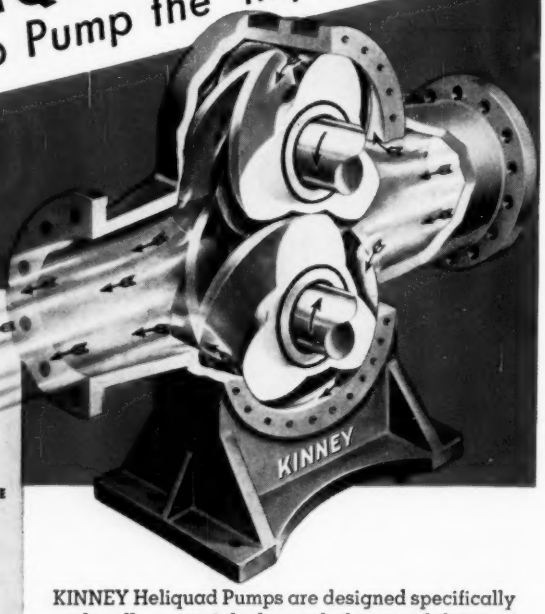
(Niagara Filters, Europe: Kwakelpad 28, Alkmaar, Holland)

SPECIALISTS IN LIQUID-SOLIDS SEPARATION BY PRESSURE-LEAF, PLATE and ROTARY VACUUM FILTRATION and CENTRIFUGAL EXTRACTION

Kinney®

HELIQUAD® PUMPS

Ask to Pump the "Impossible"





THREE IMPELLER DOUBLE HELICAL ROTOR



FIVE IMPELLER SINGLE HELICAL ROTOR



FIVE IMPELLER DOUBLE HELICAL ROTOR



SEVEN IMPELLER DOUBLE HELICAL ROTOR

KINNEY Heliquad Pumps are designed specifically to handle materials beyond the capabilities of other pumps . . . heavy viscous materials, principally, that pumps of other configurations just do not handle economically. Molasses, syrups, chocolate, gums, resins, waxes, tar, asphalt or alcohols are handled efficiently. Heliquads are fixed displacement pumps and in many applications provide metered flow in either process or transfer service.

The big economy advantage for you in selecting a KINNEY Heliquad Pump is in its ability to minimize down-time and maintenance costs. Many KINNEY Pumps now in service—day in and day out rugged service—have been on the job 20 years and more. For you, there is a KINNEY Heliquad with rotors precisely suited to your needs, whether they be 10 gpm or 2000 gpm, or capacities in between.

KINNEY Heliquad Pumps handle entrained gases and non-lubricating liquids. They make money for you by doing the job other pumps can't do and by keeping production up when other pumps are down. Write for Bulletin L-54 Today!

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NAMES . . .

Co., New York, who retired recently.

Charles F. Reinke has joined the metallurgy division of Argonne National Laboratory. Reinke formerly was an irradiation coordinator for Combustion Engineering. Before that he was an engineer with Knolls Atomic Power Laboratory, Schenectady, N. Y.



Lawrence J. Horan

Lawrence J. Horan has been named manager of the Southeastern division of National Starch Products Inc. with headquarters in Atlanta, Ga. In his new assignment, he will be responsible for over-all operation and supervision of adhesives, paper and textile sales and technical service groups. He will also work on the promotion of specific products for these fields.

Horan, a chemical engineering graduate from Illinois Institute of Technology, joined National Starch in 1950 as an adhesive salesman. After three years he transferred to resin sales for the paint industry and was appointed supervisor, Midwest resin sales in 1955.

From January 1956 until his present appointment, Horan served as district supervisor, New York sales.

C. J. G. Leesemann has been appointed head of the supply and coordination division in Humble Oil & Refining Co.'s Houston office. He has primary responsibility for coordination and liaison between the refining department and other company departments, and between Houston

office and Baytown refinery and customers on matters relating to coordination of production and supply of products.

Richard J. Anderson has been named head chemist, trade sales laboratory, by United Wallpaper, Inc., Chicago, manufacturer of protective coatings and resins for industrial and consumer applications and wall coverings.

George Sherrerd, who has been in charge of the centrifugal and filtration equipment division of Bird Machine Co. for 25 years, is retiring as vice president of the company. He will, however, continue his association with Bird in a consulting capacity. **Henry H. Shepherd,** Bird's general sales manager, and **Eric Piper,** manager of centrifugal and filtration equipment sales, are assuming customer relations responsibilities formerly carried by Sherrerd.



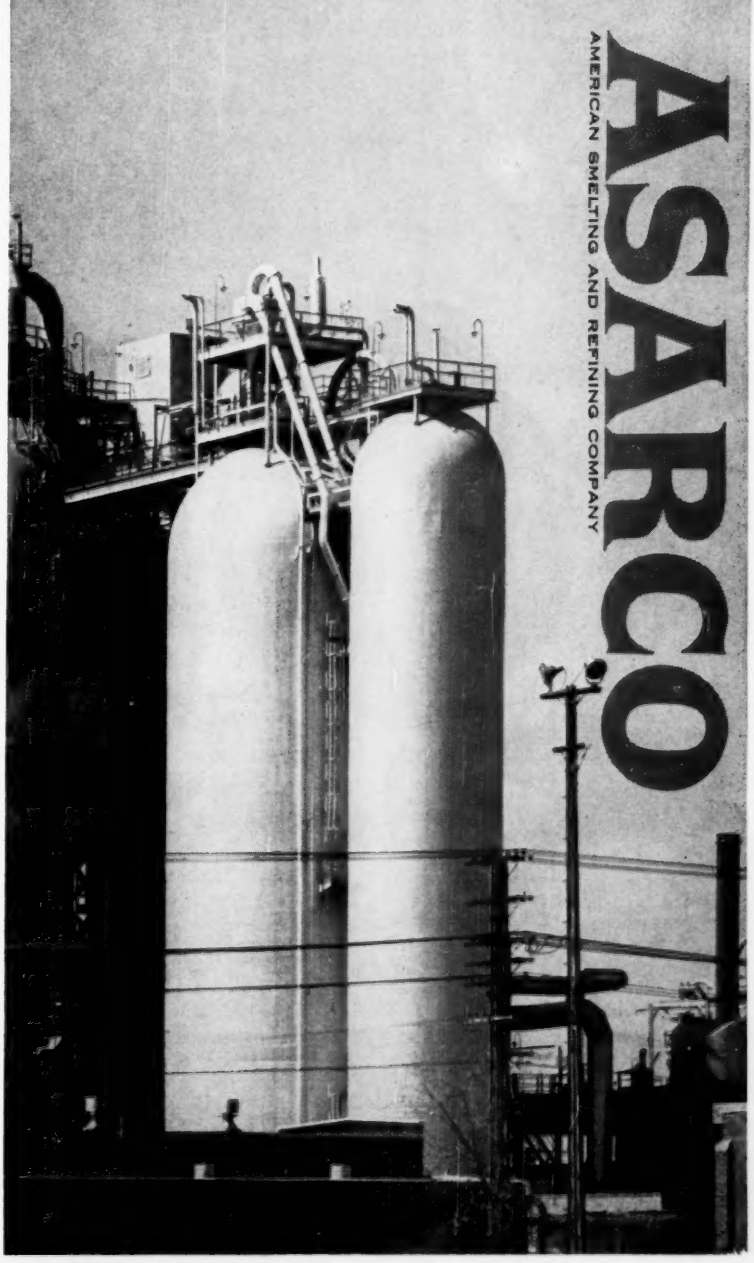
L. O. Crockett

L. O. Crockett, former vice president, petrochemicals, Gulf Oil Corp., has been elected president and chief executive officer of Goodrich-Gulf Chemicals, Inc. He succeeds W. I. Burt, newly elected board chairman.

A veteran of nearly 36 years of service with Gulf, Crockett has held a number of increasingly important positions. They include foreman of a major lubricating oil processing unit, chief chemist for three Gulf refineries, assistant general superintendent of the company's Texas refineries, manager of petro-

Federated Zinc Dust 97% minimum metallic zinc 97% thru 325 mesh. Prompt shipment from Asarco, America's leading producer. Complete research and engineering assistance. Now being used as a reducing agent, precipitating agent, purifier, catalyst, polymerizing agent, in rust-resistant paints, bleaches, pyrotechnics, soot-removal, Sherardizing, pipe thread compounds. For experimental half-pint sample, write American Smelting and Refining Company, Federated Metals Division, 120 Broadway, New York 5, New York.

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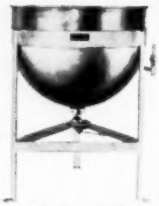


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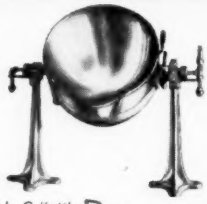
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Style CW Kettle
⅔ Jacketed, 80 to 300 gal.



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⅔ Jacketed, 5 to 500 gal.



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⅔ Jacketed, 5 to 100 gal.



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⅔ Jacketed, 40 to 200 gal.



Style B Kettle
Full Jacketed, 10 to 300 gal.



Style CW3T Kettle
with Center-Line Scraper
Agitator, 80 to 300 gal.

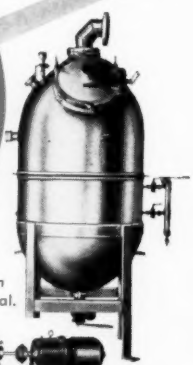
KETTLES

TANKS

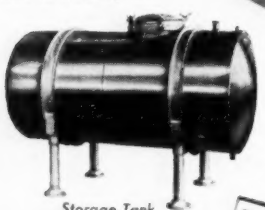
PANS



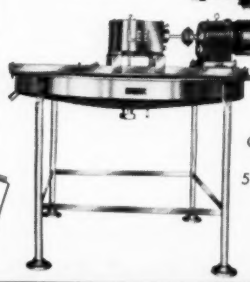
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500 to 2,000 gal.



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chemical activities, general manager of the chemical department. In 1955 he became a vice president of Gulf.

Since 1952, Crockett has been a director of Goodrich-Gulf and has been responsible for much of Gulf's relations with that company.



George F. Hornaday

Appointment of George F. Hornaday as manager of its research and development division has been announced by Houdry Process Corp.

Hornaday, who had been associate manager of the division since December, 1956, heads operations at Houdry's Linwood, Pa., research and development laboratories. Before that he was assistant process sales manager of the company.

Prior to joining Houdry in 1940 as assistant manager of development, Hornaday was with Soconoy Vacuum (now Socony Mobil) Oil Co. He is experienced in catalytic cracker operation, reactor design, technical service and participation in development of Houdry dehydrogenation process, used for production of butadiene and butanes.

MacVicker Snow has been appointed assistant secretary of Celanese Corp. of America. He's been associated with Celanese since 1953, as a member of the company's legal department.

William D. Kohlins has been named general manager of Blaw-Knox Co.'s Buflovak Equipment Division, Buffalo, N. Y. He has been serving as division manager since 1956.



Raymond W. Hess

Raymond W. Hess has retired as coordinator of pollution research for National Aniline Division, Allied Chemical & Dye Corp., after nearly 40 years with the company. He plans to continue his activities in the field of pollution abatement as a consultant. And recently his appointment as consultant-executive to the Hamburg, N. Y. Water Board was announced.

For the past 20 years Hess has been occupied with coordinating National Aniline's activities relating to operating improvements and waste problems.

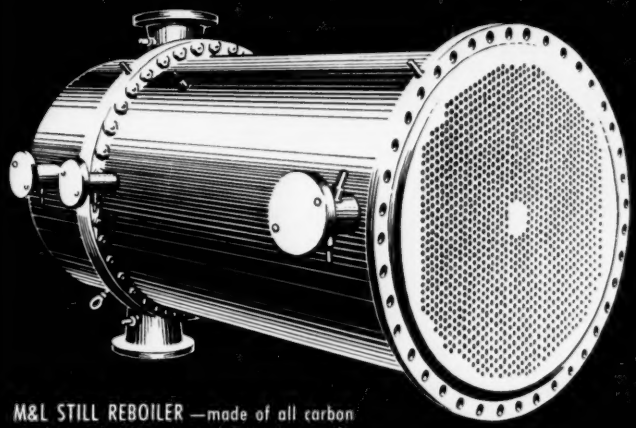
For his work in pollution abatement, Hess has received many honors. Most recently (February 18, 1958) he received a special award from Manufacturing Chemists' Association ". . . in appreciation of his many years of dedicated service" in the field of water pollution abatement.

Giulio Natta, professor at the Polytechnic Institute of Milan, has been elected a Fellow of the New York Academy of Sciences in recognition of his outstanding achievements in science—in particular for his latest revolutionary discoveries in the field of polymer chemistry.

Gordon D. Kerns has been appointed senior technologist at Vickers Petroleum Co.'s Potwin, Kan., refinery. Before joining Vickers, Kerns was manufacturing coordinator, Amoco Chemicals Corp., Chicago.

Robert L. Hart has been named district sales representative

MANNING & LEWIS



M&L STILL REBOILER —made of all carbon steel to A.S.M.E. code and T.E.M.A. specifications. (Design temp. 450°F, weight 9500 lbs., Shell—44" dia., 8'9" length, 1-1/16" thick, 1500 steel tubes—¾" O.D. x 14 B.W.G.)

Many years of experience have given us an unusually thorough knowledge of the appropriateness, adaptability and qualities of fabrication of a wide variety of metals. This accumulated knowledge, coupled with our engineering experience and the important "extras" in fabrication, is your assurance of practical trouble-free equipment at the lowest possible cost.

It is impossible, in a field requiring such wide diversification, to illustrate, or even list all the products we have been called upon to supply. An excellent case in point, however, is the Reboiler above. In its fabrication, X-Raying was performed to assure perfect welds. This example is typical of the "extra" care you can expect and get from Manning & Lewis.

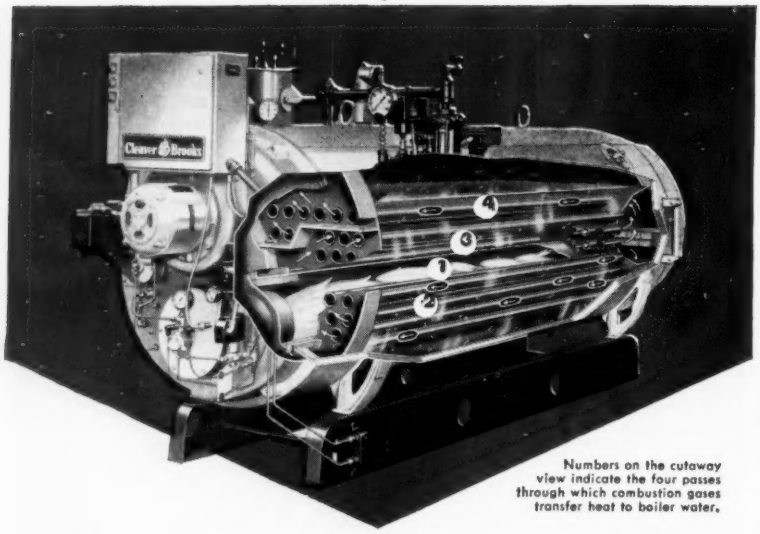
Call on us the next time you need equipment. We are fully qualified to design and fabricate to all codes.

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DESIGNERS & MANUFACTURERS OF QUALITY HEAT EXCHANGE EQUIPMENT



Numbers on the cutaway view indicate the four passes through which combustion gases transfer heat to boiler water.

Cleaver-Brooks design standards assure you lower operating costs

1 LOWER FUEL COSTS with *four-pass construction.* High heat transfer results from fast moving combustion gases passing through four complete passes.

2 LONGER BOILER LIFE and many years of uniformly high operating efficiency are the result of realistic *five square feet of heating surface per boiler horsepower.*

3 HIGH COMBUSTION EFFICIENCY is the result of proper air-fuel ratios made possible with *forced draft* design. Every Cleaver-Brooks boiler supplies its own air for combustion.

4 GREATER SAFETY with *updraft* construction. Low furnace location keeps hottest combustion gases deep within the boiler water.

Four pass construction, forced draft, five square feet of heating surface per boiler horsepower, updraft construction — these are the four Cleaver-Brooks design standards that constitute an accurate yardstick of boiler value.

They keep your steam costs low. They assure minimum 80% operating efficiency under a wide range of loads. They mean safe, dependable boiler operation under toughest operating conditions. You can select Cleaver-Brooks boilers in 19 sizes, 15-600 hp, 15 to 250 psi. For more information, see your Cleaver-Brooks boiler representative or write Cleaver-Brooks Company, Dept. D, 345 E. Keefe Ave., Milwaukee 12, Wisconsin.

Leading chemical companies are repeat buyers of Cleaver-Brooks boilers

These well-known companies in the chemical industry know the importance of dependable, low-cost steam for their plant operation. They're repeat buyers of Cleaver-Brooks boilers.

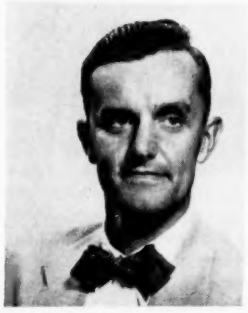
Interchemical Corporation
Chas. Pfizer & Co.
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Celanese Corporation
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Olin Mathieson Chemical Corp.
Avon Products, Inc.
Virginia-Carolina Chemical Corp.

Cleaver Brooks®

ORIGINATORS OF SELF-CONTAINED BOILERS

of Sinclair Chemicals, Inc., with headquarters in Philadelphia. Hart joined Sinclair Refining Co. in 1950 as an industrial sales engineer. In 1954 he went with Sinclair Chemicals as a sales engineer in Chicago.

David S. Devendorf recently joined the products research department of the soap products division of Procter & Gamble. **Jimmie K. Dyer** joined the company's development department of the exploratory division.



Richard F. Warren

Richard F. Warren has been appointed supervisor of American Cyanamid Co.'s newly formed commercial information center. The center, a part of the commercial development division, not only receives and processes commercial information, but also serves as a clearing house for information requests concerning Cyanamid products.

Warren has been manager of sales service and statistics, industrial chemicals division. He joined Cyanamid as a senior market analyst in 1951. Earlier he was an editor of *Chemical Engineering.*

Elton R. Beverly has been named group supervising engineer at Allied Chemical & Dye Corp.'s synthetic fiber plant operated by National Aniline Division at Hopewell, Va. **Stanley P. Anderson** has been named group engineer—vat colors, of the Buffalo, N. Y., plant of National Aniline Division. He will be in charge of vat color plant de-

sign, succeding Beverly in this position.

George L. Gouker, formerly assistant superintendent at the Fernandina, Fla., plant of Rayonier, has been appointed general superintendent for Alaska Lumber & Pulp Co.'s pulp mill under preliminary construction at Sitka, Alaska.

B. D. Thomas has been elected president of Battelle Memorial Institute.

W. K. Jackson, former director of the chemical division, Cosden Petroleum Co., has been appointed vice president of research and development, Vickers Petroleum Co., Wichita, Kan. **Dewey Mark,** former chemical sales manager of Cosden, has joined Vickers Chemicals, newly formed division of Vickers Petroleum, as its general sales manager. **A. B. Mullaly,** former president of Advance Solvents and Chemical Co., N. Y., has been named vice president of market and market development for Vickers Chemicals.

Richard G. Glover has been appointed product sales manager of acids, heavy chemicals and specialty chemicals for Monsanto Chemical Co.'s inorganic chemicals division (St. Louis), after serving as a member of that division's engineering and development staff since 1956. **David S. Plumb** has been appointed director of a newly formed divisional development department of Monsanto's plastics division at Springfield, Mass.

A. M. Gemassmer, James D. Mahoney and Wiliam W. Schneider have been named to the board of directors of Mobay Chemical Co. of Pittsburgh, Pa. Gemassmer, vice president and technical director of Mobay, was formerly associated with Farbenfarbriken Bayer. Mahoney, Mobay's general sales manager, was associated with Monsanto before coming with Mobay when the company was formed in

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SPECIFY
SIFCO
STAINLESS INSERT
FLANGES

• POSITIVE SAVINGS •
• POSITIVE SEALING •
• POSITIVE IDENTIFICATION •
• POSITIVE BOLT HOLE ALIGNMENT •

You're certain of the right corrosion resistant insert flanges for coupling your process piping when you specify "SIFCO". Each SIFCO insert is permanently identified for manufacturer, pipe size, pressure, grade and heat code; each carbon steel flange is similarly identified to assure positive identification.

Other familiar and dependable SIFCO advantages are:



• LOW ORIGINAL COST—Only the insert is of corrosion resistant alloy—the flange itself is of economical carbon steel.

• MAXIMUM SEALING—Leakproof joints are assured by true concentric grooves on the gasket face.

• FASTER BOLT HOLE ALIGNMENT—Only SIFCO flanges can be rotated easily into position after inserts have been welded, threaded, or rolled to pipes or fittings . . . exclusive SIFCO feature eliminates bolt hole alignment problems.

There are many sizes of SIFCO stainless steel insert flanges —all identified by number and code—in these 4 styles:

SLIP-ON—offers the most economical flange for welding to pipe or fitting.

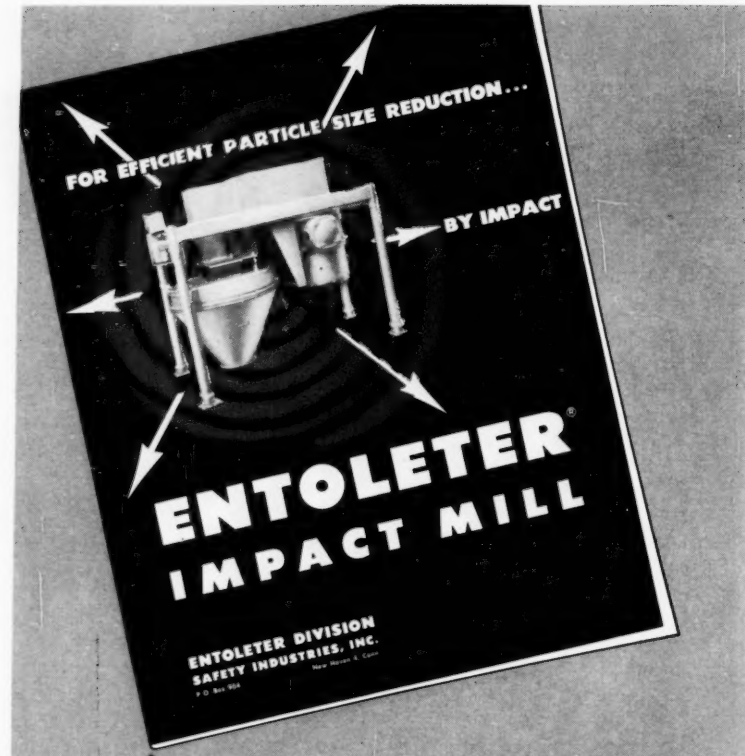
ROLL-ON—for use where welding, van stoning or threading is not desirable. Can be assembled by a simple expanding method.

SOCKET TYPE—provides ideal welding features to insure leakproof joints.

THREAD-ON—assures tighter threaded connection and can eliminate back welding, achieving bolt hole alignment without loosening thread.

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- COST ECONOMY... initial, operating maintenance and space
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THE HOWE SCALE COMPANY
SI HANDLING SYSTEMS

NAMES . . .

1954. Schneider is vice president, finance and general counsel for Monsanto.

Alfonso de Leon, Lecheria, Mexico, has been appointed to the newly created position of production manager of the Monsanto Mexicana, S. A. plant at Lecheria after serving as plant superintendent there since 1956.

J. Frank Henderson, minerals industry design and construction specialist, has joined Kaiser Engineers as a development engineers, minerals division.

James Cooperman, research chemical engineer at Armour Research Foundation of Illinois Institute of Technology, will head unit operations of the applied chemistry section at the Union of Burma Applied Research Institute.

Alex Lewis, Jr., has been promoted to manager, petrochemicals department, Gulf Oil Corp. He previously was in charge of chemical marketing for the petrochemicals department and will succeed L. O. Crockett who was recently elected president of Goodrich-Gulf Chemicals.

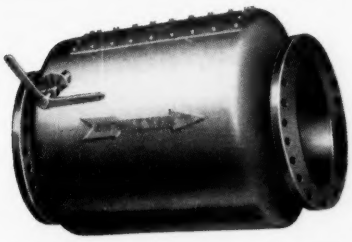
OBITUARIES

Paul L. Swisher, 59, vice president and a member of the board of directors of Reichhold Chemicals, Inc., died suddenly March 9 of a heart attack in North Tarrytown, N. Y.

Berne L. Woolley, manager of research and development at the Buffalo plant of National Aniline Division, Allied Chemical & Dye Corp., died suddenly of a heart condition on March 9.

John B. Whitney, retired chemical engineer of Upper Montclair, N. J., died March 11 after a long illness. Whitney, a specialist in the design, construction and operation of sulfuric acid plants, was 76 years old.

NORWALK ENGINEERED CHECK VALVES



Series 1300 Steel Fabricated

Positive Check OF BACK PRESSURES

in pipe sizes from 3/5" to 42" and larger

Norwalk custom engineered Check Valves provide absolute protection against reverse flow of gas and air and operate at full capacity with negligible pressure drop. Rugged construction and time-tested features assure dependable performance with practically no maintenance. Custom built for special and standard horizontal or vertical installations in any size pipe.

Norwalk valves and engineering assistance provide a complete service that meets every gas and air control problem.

For positive control of gas and air — Call Norwalk.

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Manometers Pressure or Vacuum.
Pressure Controllers Pressures to 5 psi.
Appliance Regulators Pipe Sizes 1/2" to 2".
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Bescom Corp., Ltd., Montreal



This man, cleaning a tank-truck interior of alkyd resin deposits, accomplishes



Oakite Interior Tank Cleaning Unit, Model 531. Automatically sprays hot cleaning solution under pressure. Nozzles rotate vertically and horizontally. Rinses after cleaning. Sprays 45 gal/min at 150 lbs. pressure.

18 hours cleaning in 1 hour

At a New England chemical plant, it used to take three men working six hours to clean out each truck tank—two men inside the tank scrubbing, scraping and sloshing, one man astride the dome to watch in case the oxygen tanks gave out. Even at that, a careful inspection was needed to make sure the tank was properly clean.

That's how it *was*. Now, one man equipped with the Oakite 531 Interior Tank Cleaning Unit, using a cleaning solution recommended by the local Oakite representative, does the whole job in one hour flat. A sweet job, too, with the tank interior shining like new.

It's just one of the many ways Oakite methods and materials save time and money in chemical plants . . . and why you may find it well worth your while to call in your local Oakite man. Meanwhile, for details about Oakite tank cleaning equipment and Oakite cleaning methods for the chemical industry, write to Oakite Products, Inc., 16H Rector Street, New York 6, N. Y.

Technical Service Representatives in Principal Cities of U. S. and Canada

Export Division Cable Address: Oakite

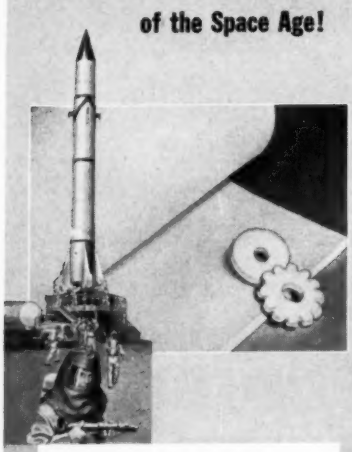
SPECIALIZED INDUSTRIAL CLEANING
OAKITE
MATERIALS · METHODS · SERVICE
SCIENCE

In our 50th year.

SYNTHETIC—FIBER

FEUTRON FELTS

...meet the DESIGN CHALLENGES of the Space Age!



Exclusive Thermal and Chemical Properties Are Combined in These Newest of Engineering Materials

NOW – Conquer your most exacting design problems with this *completely new* class of materials!

Feutron Felts are mechanically interlocked, synthetic fiber, engineering materials...perfected after years of research by American Felt Company.

Durably fabricated from selected man-made fibers – Rayon, Nylon, Dacron,[1] Orlon,[2] Dynel,[3] Arnel,[4] Acrilan[5] – they provide *all* the valuable operating properties of these synthetics... high tensile strength; superior resistance to acids, alkali, solvents and other chemicals or gases; dimensional stability; three-dimensional physical properties *plus* the ability to operate at temperatures up to 400°F!

You'll find Feutron Felts are being used for wet and dry filtration, as high temperature oil seals, as reinforcements for plastics, as rugged gaskets, as lubrication wicks, as thermal and acoustical insulation and in hundreds of other vital applications.

Where could you be using Feutron Felts to improve product performance? Get all the facts... write today, for Feutron Data Sheet, on company letterhead please.

Remember: American Felt Company has the most extensive and best equipped staff of product engineers in the Felt industry... ready to help you select the most efficient wool or synthetic fiber Felt for your application.

General Offices and Engineering and Research Laboratories
117 Glenville Road
Glenville, Conn.

American Felt Company

1. Du Pont polyester fiber trademark.
2. Du Pont acrylic fiber trademark.
3. Carbide & Carbon Chemicals Co. acrylic fiber trademark.
4. Celanese Corp. triacetate fiber trademark.
5. Chemstrand Corp. acrylic fiber trademark.

PEOPLE . . .

FIRMS IN THE NEWS

R. A. LABINE

NEW FACILITIES

This Month's Top Projects:

Goodyear's new polyester laminating film, Videne, will be manufactured in a new $9-million plant at Apple Grove, W. Va. The 100,000-sq.-ft. plant, located on a 300-acre site, is expected to be in full production by spring of next year.

Texas Eastman is boosting polyethylene capacity at its Longview, Tex., plant to a whacking 85 million lb./yr. Increase will include both low-density type and the new medium-density product; Girdler is handling engineering design.

Kennecott Refining Corp. has awarded M. W. Kellogg Co. the design and construction contract for the firm's new electrolytic copper refinery at Baltimore, Md. Cost—$30 million, capacity—16,500 tons/mo.

Du Pont has started construction on a 56-million-lb./yr. Dacron fiber plant at Old Hickory, Tenn. The multimillion-dollar unit will swing into production in mid-1959.

Dixon Chemical & Research Inc., Newark, N. J., will add a 20,000-ton/yr. aluminum sulfate plant to its Newark facilities. Due on stream early next year, plant's capacity will be expandable to 40,000 tons/yr.

Mines Development, Inc., is spending $350,000 to modify its Edgemont, S. D., uranium mill to allow more flexibility in the processing of varying types of Black Hills ore. Major change is installation of eluex uranium-extraction process.

Coastal Chemical Corp. is erecting a 150-ton/day ammonia unit at the Pascagoula, Miss., plant where firm makes sulfuric and phosphoric acids. Production will go into ammonium phosphate fertilizer.

Dow Chemical is building its own marine terminal at Bay City, Mich., to take full advantage of the St. Lawrence Seaway when it opens in 1959. Terminal will handle Dow's full line of Midland Div. products.

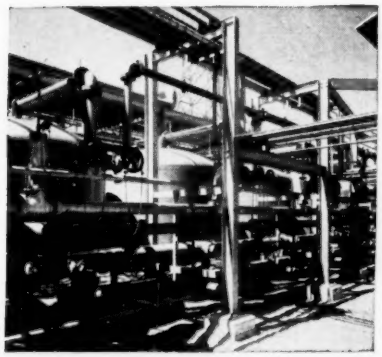
Columbia Western Corp. will build a $1.7-million coal carbonization plant at an undetermined site in Wyoming. Unit will incorporate new low-temperature coking process, have a 1,000-ton/day coal throughput.

U. S. Chemical Milling Co. is initiating a 50% expansion of its Manhattan Beach, Calif., plant. Slated for full operation by late spring, the 50,000 added sq. ft. will house an additional 100 technicians and cost over $500,000.

Pennsalt Chemicals Corp. is expanding hydrofluoric acid capacity at its Calvert City, Ky., plant by an estimated 50%. July is scheduled completion date.

Tidewater Oil Co. has completed construction of a new 22,500-bbl./day catalytic re-

ILLCO-WAY
ionXchange
filters



FOR PRODUCTION OF
ClearWater

In the design and manufacture of water-treating equipment, it often becomes necessary to include a filter of some type in the line-up in order to insure clarity and cleanliness of the water going to the next step. The picture above shows a large filter installation (in this case, at an outdoor location), one of many we have planned and produced to meet particular conditions or situations.

DIFFERENT TYPES
MANY APPLICATIONS

The filters we make may be any of the various types usually associated with the cleaning of water. Possible applications are numerous and may include such functions as removal of iron, rust, and manganese, removal of turbidity and suspended solids, clarification of lime-softened water, removal of free chlorine, organic matter, tastes, and odors, and various other special filtering requirements. *Whatever filters are needed in a water-treatment system, we are prepared to produce them.*

ILLCO-WAY
ILLINOIS WATER TREATMENT CO.
840 Cedar St.
Rockford, Ill.

NEW YORK OFFICE: 141 E. 44th St., New York 17, N.Y.
CANADIAN DIST.: Pumps & Softeners, Ltd., London, Ont.

EASTERN PORTABLE MIXERS

especially designed for small batch processes



offer . . . precise mixing results with long term cost savings

Eastern Portable Mixers are especially designed for dependable, low cost service in small batch processes. Where fixed mounted installations are not required, Eastern's Portables offer greater versatility, ease of handling, and long term cost savings.

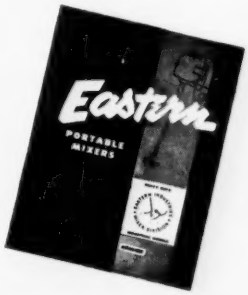
Speeds of 420, 1125, and 1725 R.P.M. rated from 1/20 to 3 H.P. are standard, with variable speed and air-driven models also available. Motors in all standard types can be supplied in semi-enclosed, totally-enclosed, or explosion-proof construction. Shafts and single or dual propellers are available in a choice of alloys for all service requirements. New optional ball-swivel clamp as illustrated, permits easy adjustment of mixer position in tank.



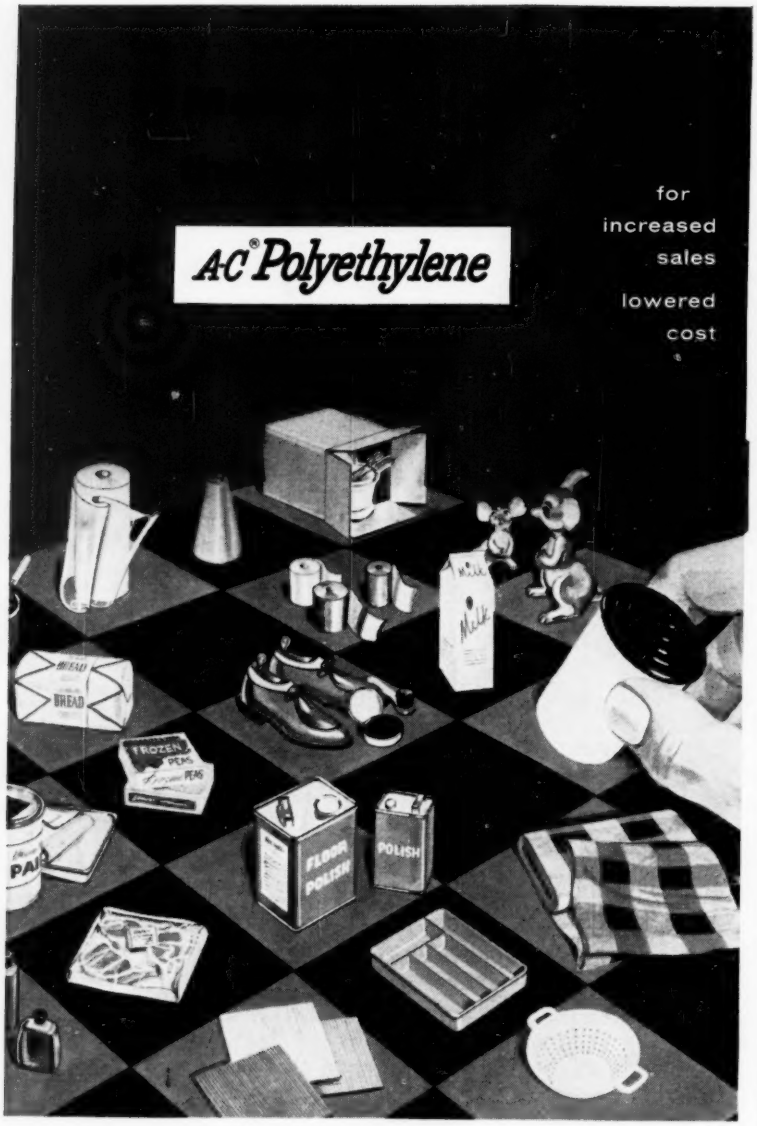
For a personalized analysis of your mixing problems, send details to Eastern engineers. A recommended solution will be furnished promptly and without obligation. For a helpful guide to mixing fundamentals, write for "Handbook of Fluid Mixing."

NEW PORTABLE MIXER BULLETIN

Eastern's improved line is included in the revised Portable Bulletin No. 530-B.



Eastern
EASTERN INDUSTRIES • MIXER DIVISION •
INDUSTRIES, INC.
MIXER DIVISION
Regent Street
East Norwalk, Conn.



All of these products are enhanced because they are produced more profitably or have improved end-use characteristics. In most cases, it's *both*. Find out today what A-C Polyethylene can do for *you*.

SEMET-SOLVAY
PETROCHEMICAL DIVISION
Allied Chemical & Dye Corporation
Dept. 523-A • 40 Rector St., New York 6, N.Y.

Allied Chemical

former at its Avon refinery near San Francisco. Also scheduled to be completed this year are a 500,000-lb./hr. fluid-coke-fueled steam generating plant and a 560-gal./-min. water treating plant.



Bethlehem Steel Co. is now operating this country's first integrated landbased tank-cleaning plant at the firm's Hoboken, N. J., ship repair yard. New plant speeds cleaning of tankers and barges in both "clean" and "dirty" trades.

Callery Chemical's abuilding high-energy fuel plant at Muskogee, Okla., is moving ahead at full speed: Two of the four processing areas have gone into operation. Both sections will produce intermediates for HiCal—the liquid fuel for jet aircraft and missiles.

Union Tank Car Co. is building a large steel dome building in Baton Rouge, La.—first major industrial use of dome construction. The geodesic structure, 116 ft. high and 375 across at the base, will house tank car maintenance facilities. Cost will be $1 million, considerably less than a conventional structure of the same size.

Continental Oil Co. has awarded Babcock & Wilcox the contract for a 180,000-lb./hr. steam boiler for Conoco's 52,000-bbl./day crude oil refinery at Lake Charles, La.

Kaiser Industries' world headquarters, and that for 50 affiliated companies, will be located in a $45-million Kaiser Center being built in Oakland, Calif. Main unit of the

7-acre center will be a 28-story office building.

Island Creek Coal Co. plans to build a coal carbonization research laboratory in Holden, W. Va., adjacent to the recently expanded quality control lab.

General Electric will start construction in May on a new plant for its Computer Dept. in Deer Valley Park near Phoenix, Ariz. Cost—$4-5 million, size—104,000 sq. ft.

Fremont Minerals has awarded the construction contract for its $3.5-million uranium processing mill at Riverton, Wyo., to Western-Knapp Engineering Co. Mill features dual leaching circuits to handle both high-lime and low-lime ores.



Southwestern Engineering Co. has moved its Separator Div. into new and expanded plant facilities in Los Angeles. Shown is final phase of separator assembly in the 40,000-sq.-ft. plant.

Ciba Co., supplier of dyes, plastics and chemical specialties, is building an 80,000-sq.-ft. headquarters building in Fair Lawn, N. J., near most of its manufacturing sources.

Foster Wheeler will provide mechanical design and construction for expansion of the Port Jerome, France, refinery of Esso Standard Societe Anonyme Francaise. New Units are: Detergent alkylate



Dramatic Money-saving approach to blending, dispersing, emulsifying

Some Typical Applications of GTA

Wax emulsions
Resin emulsions
Pigment dispersion
Adhesives
Fat emulsions
Experimental coating colors
Chemical reactions
Pharmaceuticals
Dope dyeing
Light ink dispersions
Leather finish
Carbon black dispersion
Vinyl-pigment dispersions
Grease and petroleum production
Suspensions
Cosmetic and hand cream blending
Soap processing
Latex compounding

Gaulin *Particle Control* . . . plus GTA . . . gives you the *right* answer on the most inexpensive method to disperse, emulsify or blend your product.

- Homogenizers in GTA Bulletin H-55.
- Sub-Micron Dispersers in GTA Bulletin SMD-55.
- RE* Colloid Mills in GTA Bulletin C-57.
- Laboratory Homogenizers in GTA Bulletin LH-55.

GTA shows how to: Improve uniformity; stop separation; accent taste; improve texture; speed chemical reactions; reduce amount of materials needed; and easily control and duplicate your product.

It's easy to try Particle Control. Rent a Gaulin Laboratory Homogenizer or Colloid Mill for only $75.00 a month and see how your product can be made better, faster and cheaper.

Gaulin TRADE MARK
MANTON Gaulin MANUFACTURING CO. INC. EVERETT, MASS.

71 Garden Street, Everett 49, Mass.

World's largest manufacturer of stainless steel reciprocating, rotary, pressure exchange pumps, dispersers, homogenizers and colloid mills



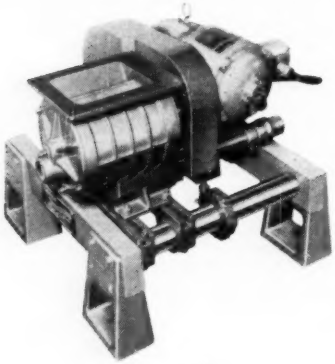
The Superior "FLUIDIZER" Conveying System offers modern, low-cost handling of most powders, flakes, beads and fine granulars!

THE SUPERIOR "FLUIDIZER" has outmoded and replaced many standard pneumatic and mechanical conveying devices in chemical plants. It's the industry's most advanced bulk handling system, with many advantages over other systems; high solids-to-air ratio, low power requirements, 50 to 1000 lb. per minute capacities, a complete line of accessories for easy adaptation to automatic operations.

Companies with "FLUIDIZERS" have found them economical to purchase and install. They have found them economical to operate. Many manual jobs and production losses due to manual handling have been eliminated. And, their quality control programs are at new highs.

You, too, may find the Superior "FLUIDIZER" the solution to high production costs. We'll be glad to demonstrate its many profitable advantages. Write or call your nearest Superior sales office.

SUPERIOR IS SELLING ENGINEERING "KNOW-HOW" AND PRODUCTION SKILL



Here is the heart of the industry's finest bulk handling system—the "FLUIDIZER" valve. And here's where Superior's engineering and craftsmanship pays off. The rotor tips, for example, in this star-type rotor are adjustable so that proper clearances can be set for various materials. These clearances must be kept to an absolute minimum, and they may vary only between .001 and .005. This minimum leakage is reflected directly on your horsepower requirements and flow of material. This is only one of the many reasons why so many of the nation's leading chemical manufacturers and processors are handling their materials with a Superior "FLUIDIZER".

MODERN Air HANDLING

Superior

"FLUIDIZER" CONVEYING SYSTEMS

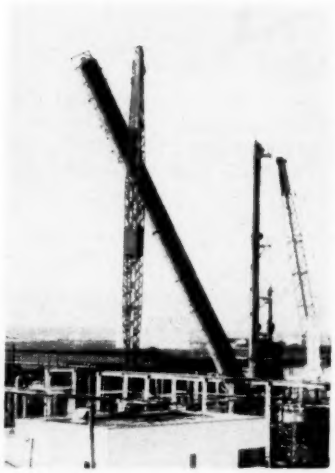
PROCESS MACHINERY DIVISION • SUPERIOR SEPARATOR COMPANY

121 South Washington, Hopkins, Minnesota, WEst 8-7651 • 18120 Dixie Highway, Homewood, Illinois, SYcamore 9-5172 • 1761 West 5th Ave., Columbus 12, Ohio • 919 D East California Street, Pasadena, California, RYan 1-9724 • 618 Meadows Building, Dallas, Texas, EMerson 1-5864

"FLUIDIZER" IS A REGISTERED TRADEMARK OF THE PROCESS MACHINERY DIVISION OF SUPERIOR SEPARATOR COMPANY, HOPKINS, MINNESOTA

plant; production unit for ethylene, butadiene and other raw materials; lube oil additive plant; propane dewaxing expansion.

Japanese Synthetic Rubber Co. has been licensed to erect a 25,000-ton/yr. Houdry dehydrogenation unit for production of butadiene. Unit forms cornerstone of Japan's emerging synthetic rubber industry.



Champlin Oil & Refining Co.'s new HF alklyation unit has swung on stream at Enid, Okla. The 100-ft. distillation tower for the 1,430-bbl./day unit is shown being set in place by Badger Mfg. Co. crews.

Standard-Vacuum Oil Co. has awarded Fluor International a two-phase contract permitting Stan Vac to boost crude capacity of its Australian refinery by 25%.

Argus Chemical Corp., manufacturer of vinyl stabilizers and plasticizers, is shaping up plans for new plant buildings to be erected on a 3.5-acre site adjacent to present facilities in Brooklyn, N. Y.

Products Research Co., Los Angeles, has completed an addition to its manufacturing plant at Glendale, Calif., that will add 50% more space to

firm's caulking and sealing compounds plant.

Trubeck Laboratories announces completion of a new laboratory in East Rutherford, N. J. Lab will be devoted to research and development of fine organic chemicals to be used as odorants, food flavors and industrial intermediates.

Kirkhill Rubber Co., Brea, Calif., has completed installation of a new Rotocure machine in its Brea plant; giant machine cures continuous sheet rubber goods up to 72 in. wide.

E. F. Houghton & Co., maker of heat treating products and cleaning compounds, has opened a new plant and laboratory in Detroit that "greatly expands" its manufacturing capacity.

Merck recently opened a $600,000 distribution center in Los Angeles. The 63,500-sq.-ft. facility will handle products of the Merck Sharp & Dohme Div. and the Chemical Div.

Day Company of Canada, subsidiary of The Day Co., Minneapolis, Minn., is doubling the size of its Toronto, Ont., sheet steel fabricating plant.



NEW COMPANIES

Metal Alkyls Corp. is now in pilot production of new high-energy fuels. Frontier Refining Co. has a major interest in the new fuel company.

J. R. Mills & Co., Northfield, Ill., is now offering to the U. S. market woven wire cloth imported from Germany. Its line includes all weaves in all metals and alloys.

John-Lawrence Associates, new firm of engineering consultants, has been formed to advise petroleum and petro-

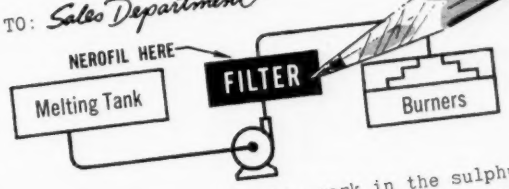
And still another industry is now benefiting with...

GLC Nerofil

THE REMARKABLE NEW CARBON-BASED FILTERAID

GREAT LAKES CARBON CORPORATION
INTEROFFICE MEMO

TO: Sales Department—



We have done considerable work in the sulphuric acid industry during the past two years, and currently some of the largest producers (using the contact process) are using Nerofil "S" in the filtration of dark sulphur. In each case, Nerofil "S" has replaced formerly-used silica-based filteraids.

Nerofil "S" was adopted primarily for its excellent clarity and high flowrate performance; Also, because Nerofil "S" has a lower cake density than previously-used materials, filteraid requirements are reduced by 20 to 30%; this also results in longer filter cycles and less sulphur lost in the spent cake. Of prime importance is the fact that Nerofil, being carbon and combustible, eliminates the danger of silica contamination in the filtered sulphur. Thus the life of the catalyst is extended.

All of these together add up to superior sulphur filtration at lower cost.

Because Nerofil is a carefully-processed carbon-based filteraid (not just crushed carbon), it gives clarity and flowrates comparable with those of diatomite filteraids. With this, plus its stability under adverse conditions, Nerofil is bringing new efficiency to 'difficult' filtrations in the production of caustics, tungsten, lithium and in other industries employing caustic solutions.

GREAT LAKES CARBON CORPORATION

Additional Note—
The stability, surface area, and other properties of Nerofil give this material definite advantages as a filler for resins, cements, etc., as a catalyst carrier; for foundry uses; and in other applications.

NEROFIL DEPARTMENT, Great Lakes Carbon Corporation
612 So. Flower St., Los Angeles 17, Calif.

Please send me further information on Nerofil

Name_____

Position_____

Company_____

City_____ Zone____ State_____

DAY

DUST CONTROL NEWS



DAY "RJ" Dust Filter Operates for Pennies NOT Dollars

DAY has simplified dust filter design *without sacrificing high efficiency*. That's why there's so much interest in the DAY "RJ" dust filter. Simplified design means fewer parts, lower operating costs and less maintenance. With the DAY "RJ" costly compressed air, complicated valves, timers, shaking or rapping devices are *NOT* required. The entire counter air flow mechanism (the reason for the "RJ's" continuous, high efficiency) is operated by one small motor which varies from ½ h.p. to 1½ h.p., depending upon the model selected.



The DAY "RJ" dust filter will handle light or heavy dust laden air streams. It filters fine, coarse, abrasive or non-abrasive dusts with outstanding efficiency ratings. Recent orders for 49 DAY "RJ" units came from 31 companies already using this filter — substantial proof of owner satisfaction. For complete specifications write toDAY for Bulletin G-579.

The **DAY** *Company*

SOLD in UNITED STATES by
The DAY SALES Company
856 Third Ave. N.E., Minneapolis 13, Minn.

DAY SINCE 1881

MADE and SOLD in CANADA by
The DAY Company of Canada Limited
28 Brydon Drive, Rexdale (Toronto), Ontario

Representatives in Principal Cities

EQUIPMENT ONLY OR A COMPLETE SYSTEM

chemical industries on product handling, both at manufacturing and marketing levels. Headquarters are in New York City.

Polybond Corp., New Orleans, La., has developed new methods for sealing leaks under pressures as high as 300 psi. with petroleum-derived plastics. Polybond sealing process is available as a contract service.



MERGERS & ACQUISITIONS

Sawyer Petroleum Co., Los Angeles, announces that it is acquiring one of the largest known thorite deposits in North America to produce thorium concentrates for missiles, aircraft and nuclear reactors. The deposit is on the extreme western edge of the Horse Prairie country in Montana.

Allis-Chalmers has purchased all machinery, equipment, inventories and patents relating to diesel operation belonging to the Micromatic Hone Corp. of Detroit.

Foster D. Snell has acquired Davis & Bennett, Inc., of Worcester, Mass., an organization of consulting chemists.

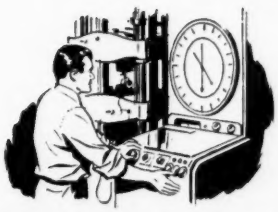
Pennsalt Chemicals has sold its I. P. Thomas fertilizer division to Dixon Chemical Industries for $1.5 million. Pennsalt retains a 70-acre tract adjacent to the Thomas plant at Paulsboro, N. J.

U. S. Chemical Milling Corp. has assumed total ownership of Missile-Air, manufacturer of intricate airborne and spaceborne components. Missile-Air has two plants in Los Angeles.

American Petrofina has completed acquisition of oil producing, refining and marketing properties of Petro-Atlas Corp., Tulsa, and its subsidi-



Premium quality extruded steel pressure tubing at standard prices



Transverse Strength, 30% to 50% higher than conventional, withstands higher internal pressures.



Improved Internal Finish offers less resistance to flow — reduces pressure drop.



Fewer and Faster Field Welds, due to close concentricity and uniform wall thickness. 50-foot lengths require fewer joints, reduce welding costs 50-60%.

High performance Chrome-Moly Alloy extruded steel pressure tubing *... in diameters from 14" to 18" o.d.... in standard wall thicknesses ... in lengths from 20 to 46 feet...* is now available *from stock* for immediate delivery at standard prices.

Other diameters, of Chrome-Moly and Austenitic Stainless, ranging from 10" to 20" with wall thicknesses ½" to 5¼" and in lengths up to 50 feet, are available on a four-month delivery schedule.

The unusual properties of this extruded tubing, such as exceptionally high transverse strength, impact strength and ductility, make it ideally suited to high-temperature, high pressure applications in the power, petrochemical, food processing and other process industries.

Contact our nearest distributor or district office. Experienced application engineers are available for consultation.

Complete Engineering and Processing Services for: ***Extrusions • Castings Forgings • Machining***

METALS PROCESSING DIVISION

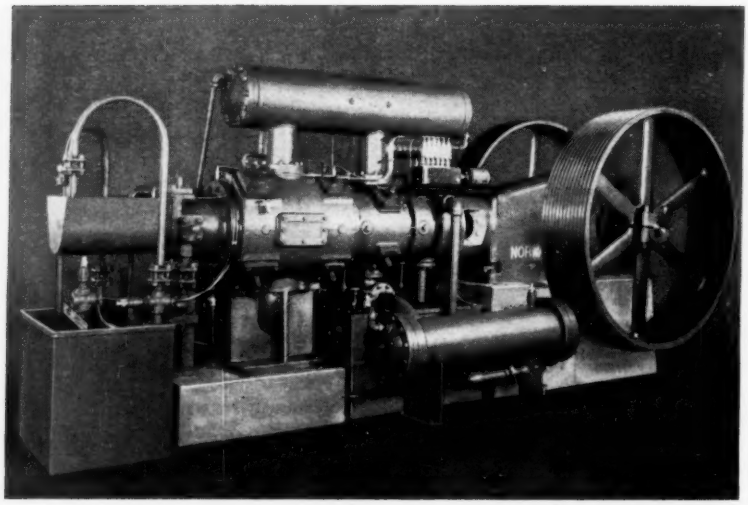
CURTISS-WRIGHT

CORPORATION • 75 GRIDER ST. BUFFALO, N.Y.

Distributors: Capitol Pipe & Steel Products, Philadelphia, Penna. • Tube Sales, Los Angeles, California • ***District Offices:*** Chicago, Illinois, 208 South LaSalle Street • Wood-Ridge, New Jersey, Main and Passaic Streets • North Hollywood, California, Van Owen & Vineland • Dayton, Ohio, 131 North Ludlow Street • Export Division, 50 Rockefeller Plaza, New York, N. Y. • Montreal, Quebec, Canada, 1980 Sherbrooke Street, West.

NORWALK

HIGH PRESSURE COMPRESSOR



The five stages on this heavy-duty tandem compressor require less horsepower and develop less heat than in four stages in producing 3000 lb. per square inch pressure in capacities up to 31,000 cfh.

Frames with double row roller bearings, reversible ring plate valves, force feed lubrication, generous intercooler coils are some of the features that make this horizontal compressor compact, sturdy and efficient to operate and maintain.

Every Norwalk compressor is test-run for eight hours at the factory, then taken down for complete inspection before re-assembly and shipment.

Norwalk makes compressors from single stage to six stages, from 125 to 25,000 lb. psi. Catalog on request.

NORWALK COMPANY, INC.

SOUTH NORWALK, CONNECTICUT

Makers of high pressure compressors since 1864

ary, El Dorado Refining Co. Total price was around $25 million.

Heyden Newport has sold its 50% interest in St. Maurice Chemicals, Ltd., of Canada to the Shawinigan Water & Power Co. in exchange for 75,000 shares of Shawinigan common stock. St. Maurice produces formaldehyde, pentaerythritol and polypentaerythritol.

Adhesive Engineering Co., San Carlos, Calif., producer of high-temperature adhesives for bonding metal skin of aircraft, has been purchased by Hiller Helicopters.

Union Tank Car Co.'s Canadian subsidiary, Products Tank Line of Canada, Ltd., has acquired Sparling Tank & Mfg. Ltd. of Toronto, Ont.

Dravo Corp. revealed that it has purchased the shops and property of Pittsburgh Screw & Bolt Corp.'s Graham Works on Neville Island for $787,500. Included are 40 acres of land and 260,000 sq. ft. shop space.



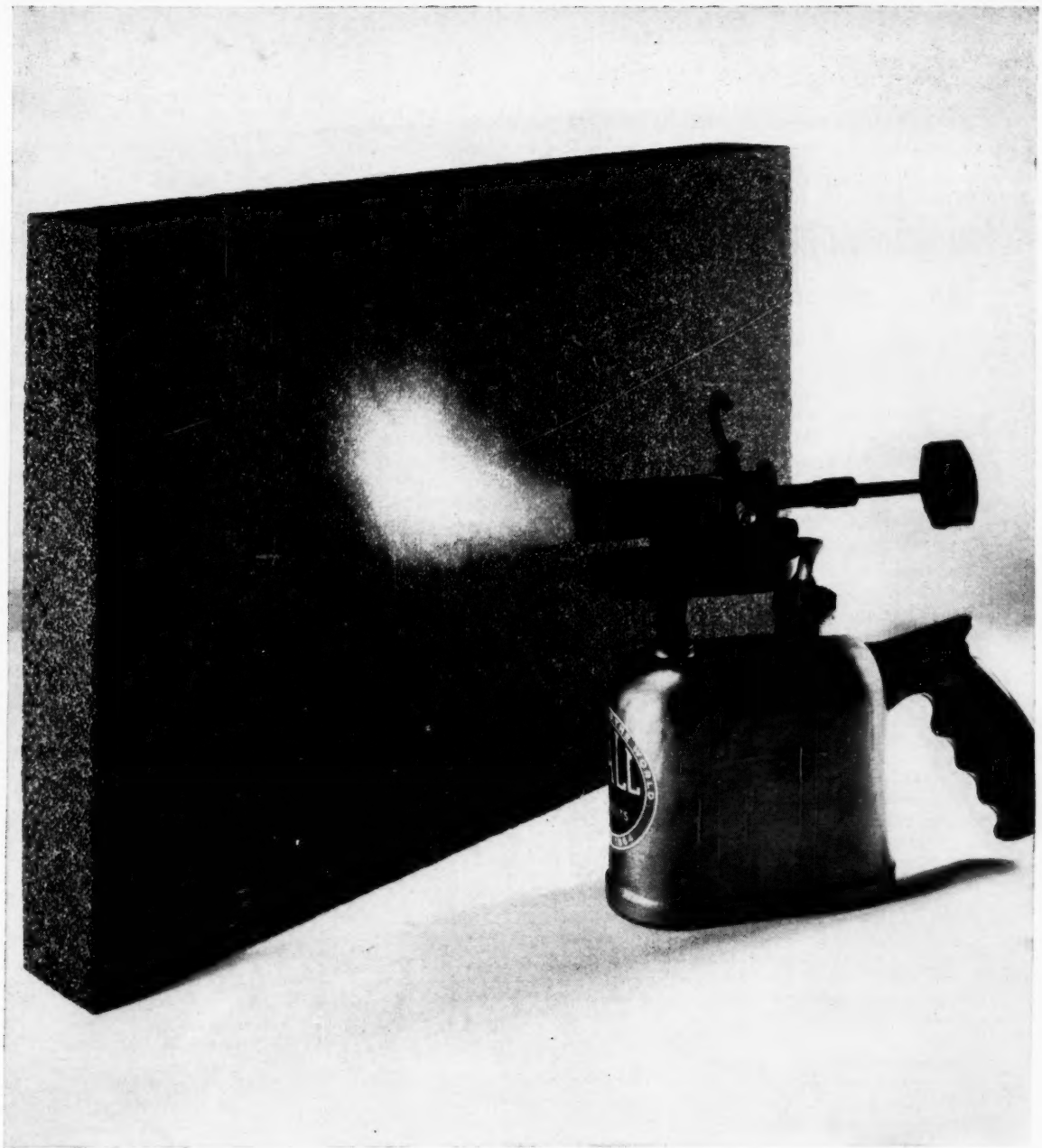
NEW LINES

Tube Turns plans to offer a complete line of welding fittings and flanges of commercial-grade titanium to match every schedule and size of titanium piping now made.

Cowles Chemical Co. of Cleveland has purchased from Monsanto a commercial laundry detergent that Monsanto marketed under the trade name Sted.

American Optical Co. is now marketing the established line of analytical instruments formerly manufactured by Patwin Instruments.

Lithium Corp. of America is now marketing lithium per-



. . . always an insulation investment; never an insulating expense

FOAMGLAS® CAN'T BURN

Most insulations are combustible. They create a serious fire hazard in insulated buildings or on piping and equipment. You eliminate that hazard when you insulate with FOAMGLAS. Composed entirely of glass, FOAMGLAS can't burn. There's more to this insulation investment story. FOAMGLAS is waterproof and vapor-proof to insure lasting insulating value. It's dimensionally stable . . . unusually strong . . . acid-proof . . . vermin-proof . . . easy, economical to handle and install. Learn how to make this safe investment in your own insulated buildings, piping and equipment. Write for our latest catalog containing complete specification and application data. PC Glass Blocks are another outstanding building product of Pittsburgh Corning Corporation.

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FANSTEEL

Corrosionomics

REGISTERED U. S. PATENT OFFICE

A JOURNAL OF USEFUL INFORMATION FOR THE SOLUTION OF CORROSION PROBLEMS

IMMERSION HEATER USES ACIDPROOF TANTALUM SHEATH

The combination of tantalum, Teflon* and a high watts density Firerod** cartridge provides an acidproof heater that proves ideal for a variety of chemical processing jobs where hot acids must be used.

High Heating Efficiency, Acidproof Construction

The electric immersion heater shown here consists of lead wires passing through a Teflon-covered copper tube and a 2000-watt, 230-volt Watlow heating element sheathed by a 6⅝" tantalum tube. Teflon and tantalum are swaged together to make a leakproof connection. The cartridge itself features a design which provides a low temperature differential between the resistance wire and the tantalum sheath. It will heat one gallon of tap water from 8°C to 96°C in 15 minutes. A gallon of 62% H_2SO_4 solution can be heated from 17°C to 142°C in 14 minutes.

Long Life in Chemical Milling Service

Chemical Contour Corporation, Downey, Calif., has used three of these tantalum immersion heaters in chemical milling service since November 13, 1957.

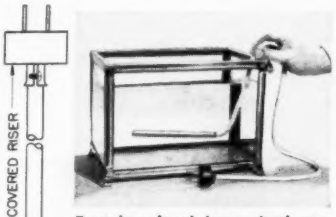
They are used in 55 gallon drum-size tanks to heat acid solutions for dissolving stainless steel. The acid is heated from room temperature to 160°F in approximately 1¾ hours, and is held to within ±5°F by intermittent heater operation.

President James H. Langworthy says: "The tantalum sheathed heaters are extremely versatile. They are easy to move, require little or no support, are easily bent to convenient shapes, are not fragile and can heat acid solutions at a great variety of depths."

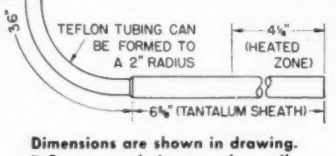
Closely Regulated Electroplating Baths

Another company uses this heater in a Watts nickel plating bath to heat this acidic solution and to hold it at 130°F. The fact that tantalum is inert to the solution virtually eliminates the metal ion contamination problem. After the first seven months of service, the heater saw 3500 hours of service with no sign of impaired performance.

Ask for our bulletin on this versatile tantalum electric heater. Tantalum corrosion data are also shown on page 748 of Chemical Engineering Catalog.



Tantalum electric immersion heater with Watlow Firerod cartridge rated at 2000 watts, 230 volts.



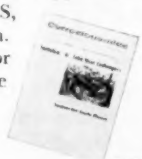
Dimensions are shown in drawing. Teflon covered riser can be easily bent to a two-inch (min.) radius for desired positioning.

Free Tantalum Test Kit

A corrosion test kit, available without charge to research technicians, if requested on your letterhead; contains both tantalum sheet and wire.

Free Technical Information

The above condensation is typical of the articles which appear in CORROSIONOMICS, a Fansteel publication. Mail us your name for inclusion on our free mailing list.



For further data on the above, write:

G583A

FANSTEEL METALLURGICAL CORPORATION

CHEMICAL EQUIPMENT DIVISION

NORTH CHICAGO, ILLINOIS, U. S. A.

***Mfg. and copyrighted by Watlow Electric Mfg. Co., St. Louis, Mo.*

**Trade Name, E. I. duPont deNemours & Co., Inc.*

FIRMS . . .

chlorate on a volume basis. This oxidizing agent contains more available oxygen on a volume basis than liquid oxygen itself.

Frontier Chemical Co. has added anhydrous hydrogen chloride to its line of chemicals. Frontier is already a major producer of chlorine and caustic soda.

Rodgers Corp., Rodgers, Conn., is now listing silicone rubber among its line of elastomeric, electrical insulation and sealing materials.

American Biltrite Rubber Co. announces the introduction of a complete new line of industrial cellular materials in addition to its line of open cell sponge for shoe manufacture.



NEW REPRESENTATIVES

Schutte & Koerting Co. of Cornwells Heights, Pa., has appointed William Thorrat Co., Cleveland, Ohio, as its representative in Northern Ohio.

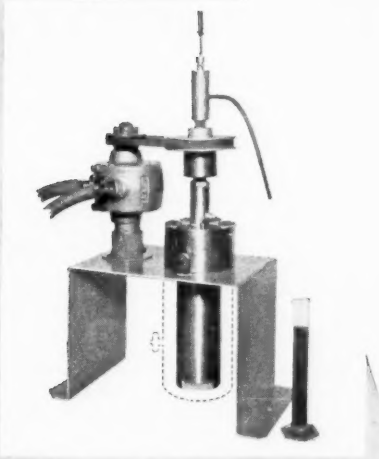
Proportioneers, Inc., division of B-I-F Industries, has picked Harris Pump & Supply Co. as regional distributor in the Pittsburgh, Pa., area.

Ford, Bacon & Davis, Inc., New York engineering firm, has concluded a world-wide licensing agreement with Commercial Solvents Corp. covering design and construction of Stengel process facilities for making ammonium nitrate.

Naugatuck Chemical has signed a national marketing agreement with Russell Reinforced Plastics Corp. to distribute reinforced plastic panels for decorative and architectural use.

Dow Chemical has launched a marketing program to make

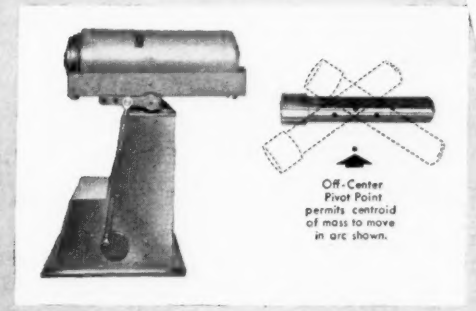
NEW... HIGH PRESSURE RESEARCH EQUIPMENT BY AUTOCLAVE ENGINEERS



0.3 lit. STIRRED AUTOCLAVE. New *bench-scale*, high pressure clave complete with agitator and drive, cooling coils, electric heating, dip tube, charging opening, gas openings. Pressure rating 5000 p.s.i. at 650°F. All wetted parts made of 316 s.s. Electric or Air drive.



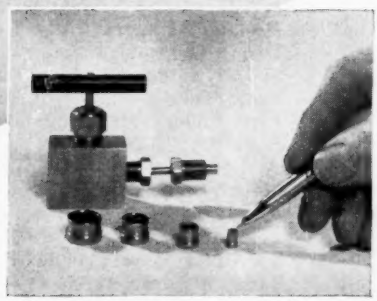
HOFER MAGNE DASH. High powered, magnetically agitated pressure vessel for large capacity or highly viscous reactions. Solenoid action external to vessel provides positive 20 lb. thrust of agitator in each direction. No springs, no stuffing box, no external moving parts. Units with even greater thrust are available.



NEW ROCKER SHAKER. *Off-center pivot point* **provides both rocking and shaking type of agitation. Adjustable arc, variable speed are other advantages of this new rocker-shaker autoclave.**

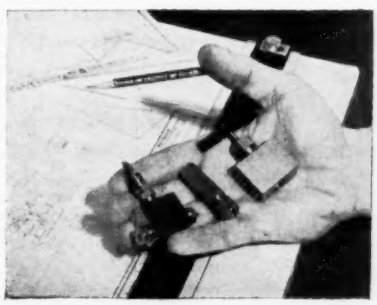
AUTOCLAVE ENGINEERS, INC

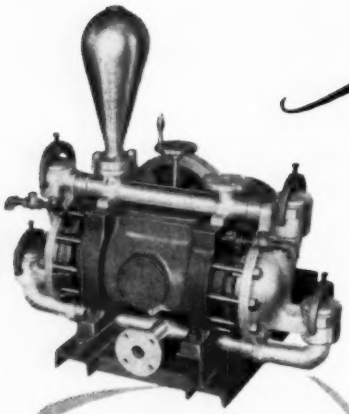
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AUTOCLAVE TUBING VALVES. Equipped with Ermeto® fast connection **Type 316 Stainless Steel** sleeves for corrosion resistance.

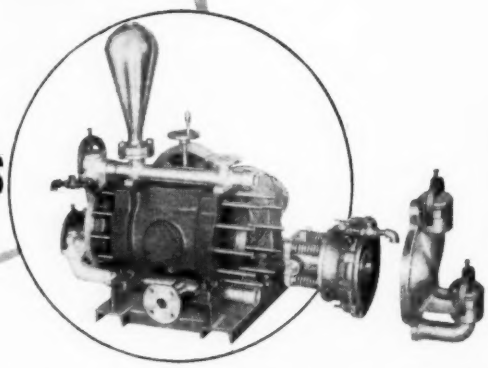




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Learn why this double acting, positive displacement, piston pump is right for your "hard-to-handle" service—corrosive abrasive, viscous, thick, heavy, quick-settling or sensitive. Write for Bulletin 143.

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FIRMS . . .

50 qualified insulation contractors throughout the country company-approved installers of Styrofoam, Dow's expanded polystyrene insulation material.

Reichhold Chemicals has appointed Martin C. Hutt Sales Co. as sales representative for polyester, epoxy and melamine resins in the Cleveland, Ohio, market area.

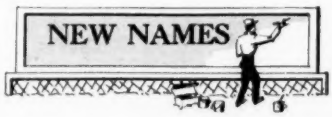


NEW LOCATIONS

National Starch Products is moving to new and larger quarters located at 750 Third Ave., New York 17, N. Y.

Water Service Laboratories, specialists in corrosion control, has moved its New York office and laboratory to 615 W. 131st St.

Enjay Co. has opened a new petrochemical sales office in Charlotte, N. C. New Address: 207 Hawthorne Lane.



Allied Chemical & Dye Corp. is about to become simply Allied Chemical Corp. Change, subject to stockholder approval, will reflect firm's diversified position in the chemical industry and will not single out a single division.

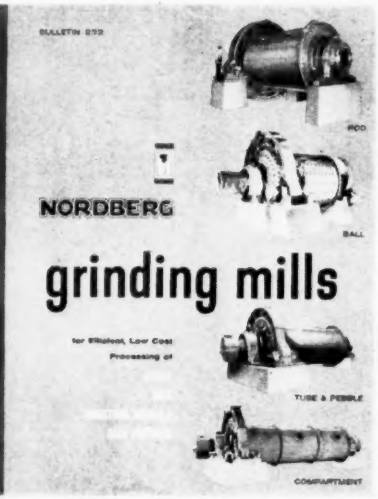
Vulcan-Cincinnati is consolidating its Vulcan Engineering Div. and Vulcan Construction Div. under one management and will operate under the name Vulcan-Cincinnati, Inc. Firm is located at 120 Sycamore St. in Cincinnati.

Bendix-Skinner Div. of Bendix Aviation is changing its name to Bendix Filter Div. to better describe company's wide range of products.

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NORDBERG GRINDING MILLS



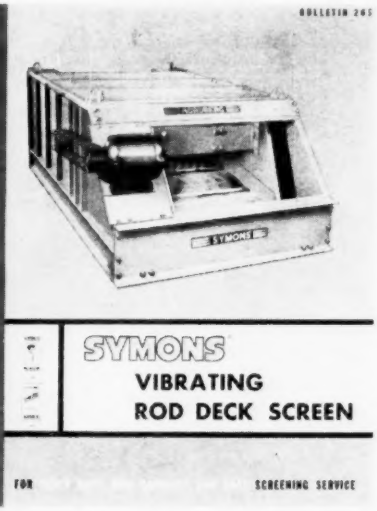
BULLETIN 232 describes the complete line of Nordberg Rod, Ball, Tube, Pebble and Compartment Grinding Mills built to meet specified conditions for wet or dry grinding in practically any process where friable material must be comminuted to fine sizes.



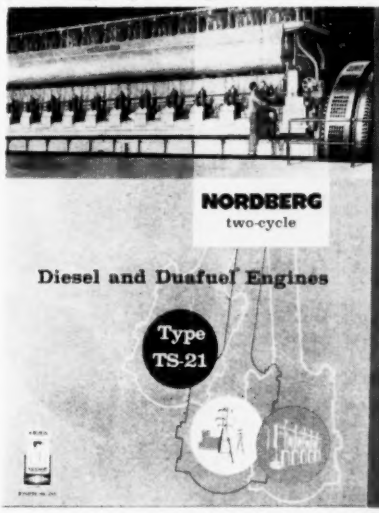
SYMONS® CONE CRUSHERS

BULLETIN 247 describes the various types of Symons Cone Crushers used in primary and secondary fine reduction crushing of ores and minerals of most every description—from Asbestos to Zinc—where leading producers have found these efficient crushers to be without equal in producing large tonnages at low cost.

SYMONS VIBRATING SCREENS



BULLETIN 265 describes the design and application of one of the many types of Symons Vibrating Screens and Grizzlies designed and built to meet requirements for positive screening with large capacity of accurately sized products . . . from primary scalping to extremely fine sizing.



NORDBERG ENGINES

BULLETIN 245 describes some of the typical Nordberg engines used, for efficient, low cost power generation. Built in sizes to over 11,000 hp, Nordberg engines are available in two and four-cycle, in-line and "V" types... for Diesel, Duafuel® and Spark-Ignition Gas operation.

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New Features:

Simplified Relamping . . . loosen one thumb screw to lift out cover and glass housing in one piece.

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13	38	57	76F	84G	92ri	105	124	178	190c	R197h	207	221b	231C	234D	236F	240C	245
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Important—For pages showing more than one advertised item use the guide to numbers on cards above.

12 All items discussed
- 12a Filters, vertical leaf
- 12b Filters, vertical batch
- 12c Filters, horizontal leaf
- 12d Filters, horizontal batch
- 12e Filters, cartridge

36 All items discussed
- 36a Detergent
- 36b Chlorides, aromatic
- 36c Caustic soda

91 All items discussed
- 91-2a-Zirconium
- 91-2b Acid, isosebacic (R)
- 91-2c Pump, liquid metals
- 91-2d Polyethlene, black
- 91-2re Iodine-methanol solutions
- 91-2rf Titanium
- 91-2rg Krypton, radioactive
- 91-2rh Polyurethane installations
- 91-2ri Ethyl diamine
- 91-2rj Polyethlene
- 91-2rk Diaminostilbene
- 91-2rl Models, atomic
- 91-2rm Silicone
- 91-2rn Pyroglutamic acid

167 All items discussed
- 167a Sand binder
- 167b Templates
- 167c Boron nitride
- 167d Ammonia

190 All items discussed
- 190a Fans, forced draft
- 190b Fans, induced draft
- 190c Dust collectors

R197 All items discussed
- R197a Agitators and mixers
- R197b Ball mills
- R197c Samplers
- R197d Crushers, jaw
- R197e Feeder
- R197f Filter, disc
- R197g Flotation
- R197h Concentration tables
- R197i Laboratory equipment
- R197j Dryers

204 All items discussed
- 204a Kettles
- 204b Tanks
- 204c Pans

221 All items discussed
- 221a Clave, high pressure
- 221b Shaker, rocker
- 221c Pressure vessel
- 221d Valves and fittings
- 221e Valves, tubing

223 All items discussed
- 223a Mills, grinding
- 223b Crushers, cone
- 223c Screens, vibrating
- 223d Engines

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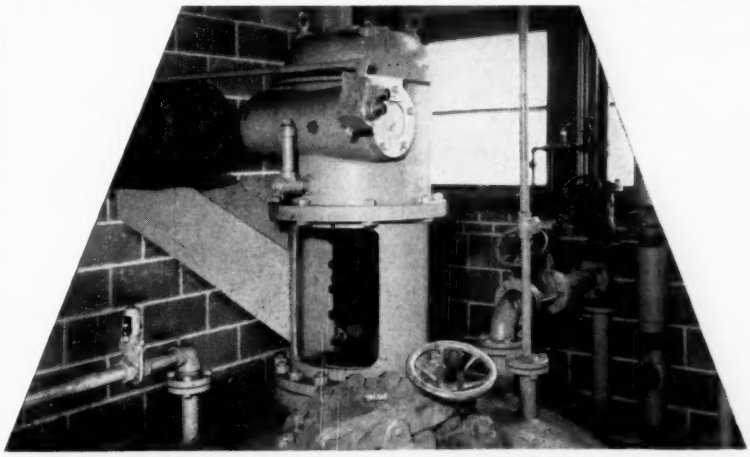
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231A Eastman Chemical Products

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231B Armour and Co.

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113 *Pittsburgh Coke & Chem. Co.

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36c *Hooker Electrochemical Co.

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231D Borden Chemical Co.

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97 *International Minerals & Chemical Corp. Potash Div.

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231G Cadillac Plastic & Chem. Co.

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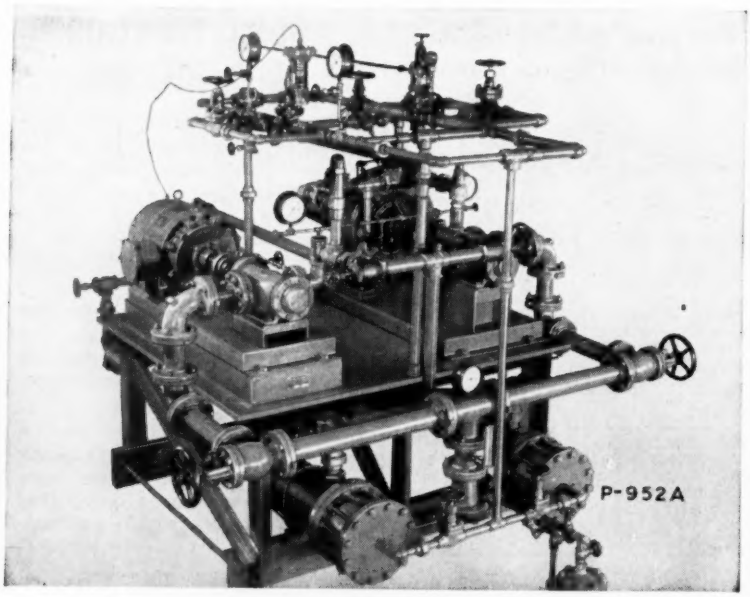
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Polyethylene.....polyethylene-to-metal adapter devised to attach polyethylene & metal pipes & fittings without using clamps. Threaded polyethylene gasket between nut & tailpiece. #1345.
92rj *U.S.I. Chem. Co.

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92rm *U.S.I. Chem. Co.

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232A Dow Chemical Co.

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26 *Du Pont, Pigments Dept.

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92rf *U.S.I. Chem. Co.

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232B National Aniline Div.

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130 *Aluminum Co. of America

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75 *Norton Co.

Coatings, protective.....Plasite protective coatings are formulated with a combination of high resistant resins to achieve highest possible chemical resistance. Write for Bulletin 258.
182 *Wisconsin Pro. Coatings Co.

Fireproofing.....Cafco fireproofing material is permanent, inorganic, light weight, incombustible, rustproof and rotproof. Used in fireproofing decks, beams, columns, ceilings, girders.
232C Col. Acous. & Fireproofing

*From advertisement, this issue

Maintenance Products.....Bulletin describes application of three products —expanding iron cement, Metalset epoxy resin compound cements, Sonite industrial maintenance kits —for repair of various materials.
233A Smooth-On Mfg. Co.

Polyurethane installations.....cost of these modern installations can easily be estimated with a nomagraph chart. Thickness, area, density of stock & price per lb. must be known. Bulletin 1343.
92rh *U.S.I. Chem. Co.

Electrical & Mechanical

Actuators, Cylinder.....Cylinder Conomotor is pneumatic power actuator used in process industries for throttling control service. Bulletin B-50-3 covers operation, application of Series 50 actuators.
233B Conoflow Corp.

Batteries, Nickel-Cadmium.....VO-Series of general purpose, sealed, nickel-cadmium batteries has cells with extremely low internal resistance. Batteries can be maintained indefinitely in fully charged state by small trickle charge.
233C Gulton Industries

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R183 *Sturtevant Mill Co.

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118 *The Falk Corporation

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186 *U.S. Stoneware

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49 *Reliance Elec. & Eng. Co.

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18 *Fairbanks, Morse & Co.

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35 *Garlock Packing Co.

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37 *Allen-Bradley Co.

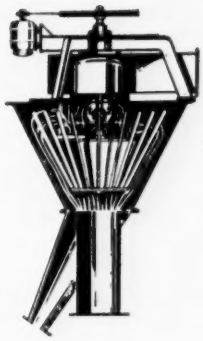
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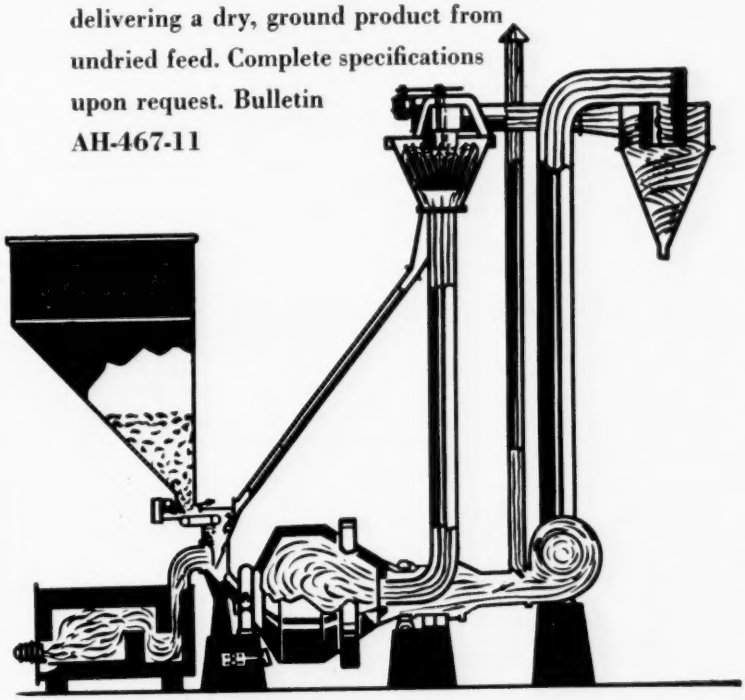
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. . . in a few minutes, without interrupting operations. Yet any desired mesh may be maintained continuously. Ease of adjustment and close product control are possible with the . . .

"Gyrotor" Air Classifier

The Hardinge Gyrotor Classifier system, combined with a Hardinge grinding mill is an integrated grinding, classifying and product conveying system. Also available with an air-heating furnace for delivering a dry, ground product from undried feed. Complete specifications upon request. Bulletin AH-467-11



HARDINGE
COMPANY, INCORPORATED

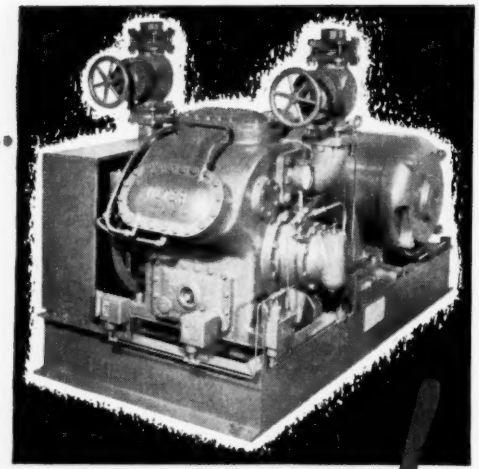
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Before deciding...

compare the

Vilter VMC



COMPRESSOR—FREON OR AMMONIA!

The compressor being the heart of the refrigeration system deserves the most attention. For dependable day-in-day-out operation, the compressor must be sturdy, well built, designed for long life. It must be easy to maintain. Naturally wearable parts must be easy to replace. You will save yourself future expense and needless worry if you see that your compressor incorporates the points below.

CHECK THESE POINTS	VILTER	5 OTHER WELL-KNOWN MAKES				
		A	B	C	D	E
1. Removable alloy steel cylinder sleeves that permit low cost, easy replacement. Eliminates need for oversize pistons, rings, etc., which are common in frame bored cylinders	Yes	Yes	No	No	Yes	Yes
2. A double bellows oil immersed shaft seal that prevents air or moisture from entering the system when operating below atmospheric pressure	Yes	No	No	No	No	No
3. A crankshaft double row roller bearing arrangement that allows the shaft to expand freely, thus preventing excessive thrust loads on the bearings	Yes	No	No	No	No	No
4. A statically and dynamically balanced crankshaft that assures smooth operation	Yes	Yes	Yes	Yes	—	Yes
5. Spring loaded safety heads that protect the compressor against refrigerant slugs	Yes	No	Yes	No	No	Yes
6. Removable connecting rod bearings that can be changed without also removing the connecting rod and piston assembly	Yes	No	Yes	Yes	Yes	Yes
7. Necessary to dismantle entire unit for repairs	No	No	Yes	Yes	No	No
8. Suitable for high stage or booster operation	Yes	Yes	No	No	Yes	Yes
9. Light weight aluminum pistons with upper half of piston wall having tapered thickness to conduct heat from top of piston. This prevents excessive piston expansion and reduces possibility of piston seizure	Yes	No	No	Yes	No	No
10. A separate oil filter, in addition to crankcase screen, to super-clean oil and thus reduce wear to a minimum	Yes	Yes	No	Yes	Yes	Yes

From this comparison, you know that *you get more for your money* with Vilter. It will pay you to consider Vilter for your next refrigeration or air conditioning installation.

Vilter®

WRITE for your FREE Vilter Bulletins: No. 817—"Vilter VMC Ammonia Compressors"—and No. 820—"Vilter VMC Freon Compressors"—to THE VILTER MANUFACTURING CO. Dept. K-719, 2217 South First Street Milwaukee 7, Wisconsin



REFRIGERATION and AIR CONDITIONING

THE VILTER MANUFACTURING COMPANY, Milwaukee 7, Wisconsin

Air Units • Ammonia & Freon Compressors • Booster Compressors • Baudelot Coolers • Water & Brine Coolers • Blast Freezers • Evaporative & Shell & Tube Condensers • Pipe Coils • Valves & Fittings • Pakice & Polarflake Ice Machines

LITERATURE . . .

Switches.....Switch assemblies of Series 100PB modular-mount lighted pushbutton switches come in three models—a light-force, a positive touch feedback and an alternate-action design.
234A Micro-Switch

Switches.....Type E general-purpose enclosed switches feature compact enclosure providing easy installation. Inside switch terminals can be exposed for easy wire connection. Data Sheet 145.
234B Micro Switch Div.

Speed Reducers.....96 p. pocket-size booklet gives complete technical data on proper selection of speed reducers. Contains information on horsepower, torque ratings; ratios, installation instructions.
234C Abart Gear & Machine Co.

Handling & Packaging

Clamps, Roll.....Simplified method of handling bulky paper rolls involves use of fork lift trucks equipped with Towmotor roll clamps. Clamps grip rolls firmly, rotate them to a vertical or horizontal position.
234E Towmotor Corp.

Containers Bulk Shipping.....Some advantages of bulk handling individualized shipping containers are: less floor space; reduced handling; elimination of capping, sealing, labeling. Bulletin 132-A.
234D Sprout, Waldron & Co.

Conveyor, Belt.....Manual No. 909 is conveyor handbook contains sections on typical applications, terminal selection tables, terminal dimensions, conveyor and belt selection, types of drives.
234F Jeffrey Mfg. Co.

Feeder.....Accurately meters minute quantities of liquid from 0 cc to 2000 cc per minute. Used in multiples for higher capacities. Float valve in tank permits connection to bulk storage device. Bul. F6-B9.
R197e *Denver Equipment Co.

Feeders, chemical.....New Chemical Feeder catalog helps you to select the right feeder for any job. Manzel feeders are accurate, and dependable. Available in different sizes. Write for catalog.
189 *Manzel

Feeders, Rotary.....complete line services processing requirements from low pressure dust control to high pressure pneumatic conveying, standard duty, heavy & blow-thru styles. Booklet P-55.
B244 *Prater Pulverizer Co.

Filler, Lube Oil.....Model RPL-36, a 36-station lube oil filter, has a speed of 600 quart containers per minute. It's accurate to ± ¼ fluid ounce; assures no product spill. Bulletin 964.
234G Pfaudler Co.

Gloves, Coated.....New line of work gloves includes neoprene, vinyl plastic- and rubber-coated gloves. Neoprene gloves resist acids, alkalis; vinyl resist oil; rubber resist cutting, abrasions.
234H Riegel Textile Corp.

* From advertisement, this issue

Packing, Corrugated.....Anchor Pak, corrugated interior packing material, has coating of pressure sensitive adhesive on tips of exposed corrugations which anchors product firmly in place.
235A Hinde & Dauch

Boom Truck.....Operator of Hydro-Boom can, by telescopic action, position work loads with machine tool accuracy to within 1/100 in. in vertical, longitudinal, cross-wise directions of travel.
235B Vanguard Engineering Co.

Heating & Cooling

Evaporators.....septuple effect evaporator cuts steam need..wastes used as auxiliary boiler fuel. Pretest your evaporating in Customer Service Lab. Catalogs 381 on the lab, 372 on evaporators.
107 *Blaw-Knox Co.

Heat Transfer Equipment.....Platecoil units are compact & lightweight, require about ½ the space of pipe coils. Available in Stainless, cold Rolled Steel & other corrosion-resistant alloys. Manual P61.
114 *Platecoil Div. Tranter Man.

Heaters, Air.....compact, high efficiency, requires no refractory. Performs equally well on gasoil or combination firing. Most frequently sold as "packaged" units with all safety controls. Bulletin 112.
239 *Thermal Research & Eng.

Heaters, water.....equipped with Booster pump that increases the capacity of the boiler. Instantaneous heating with full temperature controls. Send for booklet describing full line of heaters.
45 *Bell & Gosset Co.

Generator, Steam.....Keystone steam generator has been designed as a baffleless, pressurized two-drum water tube packaged unit. Unit needs no field piping, wiring, special foundation. Catalog SB-59.
235C Erie City Iron Works

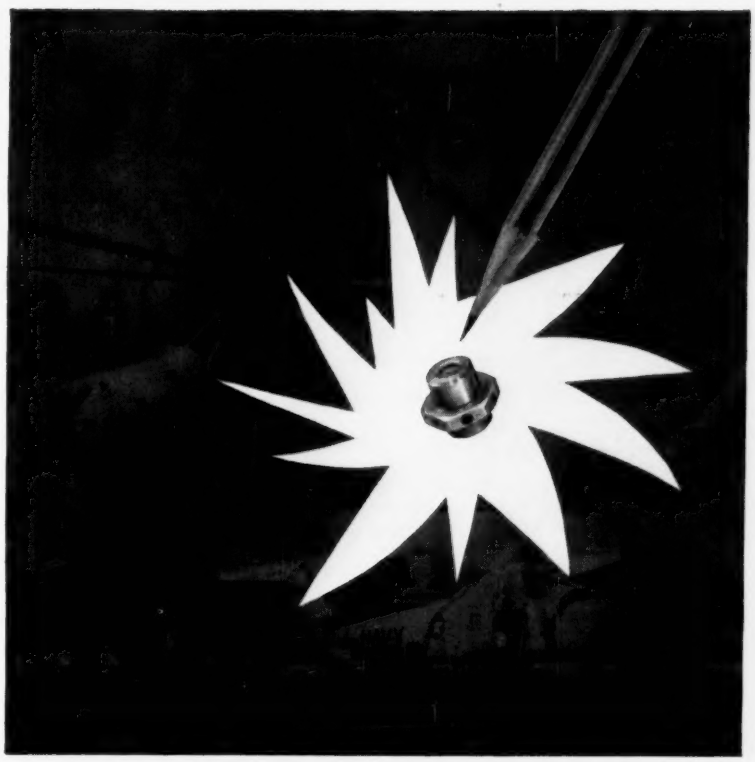
Oven, High-Temperature.....Equa-Therm oven produces temperatures from 100 to 750 F. within 17 cu. ft. work chamber. Bulletin 2299 describes unit, includes table illustrating temperature differentials.
235D American Instrument Co.

Tube, condenser.....for solving heat transfer problems. 2½ times more heat transfer surface means fewer tubes to handle duty. U-bend form saves space, facilitates installation. Send for "Trufin" catalog.
33 *Wolverine Tube Division

Instruments & Controls

Analyzer, Particle Size.....M-S-A particle size analyzer is low-cost, general purpose instrument for 0.1 to 40-micron particles. Major components are designed as separate units.
235E Mine Safety Appliance Co.

* From advertisement, this issue



16 Spraco Nozzles help the new lightweight G.E. T58 engine pack the punch of a heavyweight!



At the heart of General Electric's new T58 turboshaft engine — a revolutionary new power plant for helicopters that packs over 1,000 horsepower into a 59" long, 16" diameter, 325 pound frame — are 16 precision built steel spray nozzles.

These are special nozzles, developed for the engine by Spraco engineers. Their critical function: to feed just-right amounts of fuel into the combustion chamber.

This development is another example of the hand-in-glove cooperation, engineering service, and product quality you can expect from Spraco whenever you have a spray nozzle problem.

FREE—*The most complete spray nozzle catalog ever published. Send for your copy today!*

SPRAY ENGINEERING COMPANY,
115 Cambridge Street, Burlington, Mass.

SPRACO



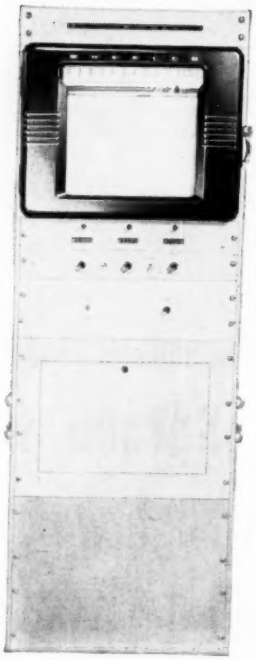
THE MARK OF QUALITY

BARBER COLMAN

Wheelco Instruments

NEW

electronic integrator provides fast, selective counting rates



New Wheelco electronic integrator and optional 5-digit component counters are unitized for convenient mounting

New from Wheelco — an electronic integrator with a selective counting rate of 2400, 1200, or 600 per minute at full scale. Developed for use with the Wheelco 8000 Series potentiometer strip chart recorder in chromotographic applications, the unit is equally effective on any industrial process where the measured variable must be integrated.

Now — control of laboratory or industrial processes that formerly required a high order of technical skill can be supervised by most competent laboratory technicians.

Recorders are available with cross-chart speeds of 2 seconds for scale spans of 1 to 10 millivolts and 1 second for spans of 10 millivolts and greater. Chart speeds are selected by change gears. Readout (optional) is provided by high-speed, 5-digit electromechanical counters for component and/or total count.

Behind this new development is a solid background of Wheelco development experience, manufacturing skill, and complete field engineering experience. These same qualities can be applied to your process control problem — contact your Wheelco field engineer for more details today.

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Industrial Instruments • Automatic Controls • Air Distribution Products • Aircraft Controls • Electrical Components • Small Motors • Overdoors and Operators Molded Products • Metal Cutting Tools • Machine Tools • Textile Machinery

LITERATURE . . .

Computer, Digital.....Bendix G-15 general purpose digital computer features low cost, simplified programming. Engineers can be taught coding techniques within two to four hours.
236A Bendix Computor Div.

Computer, Liquid.....horizontal tank content indicator free. Insures accurate inventories. Helps you plan more efficient & economical storage. Help yourself to this & other "Modern" services.
93 *Modern Welding Co., Inc.

Controls.....A complete line of controls - flexible, universal joints, geared joints. These controls also include standard remote stations. Write for complete design data on these controls. Bul. 553.
198 *Stow Manufacturing Co.

Controls, Supervisory.....20 p. bulletin supplies description, operation, application of supervisory control equipment. Includes equipment used for master and remote stations. Bulletin GET-2738.
236B General Electric Co.

Controllers, Temperature.....compact low-cost indicating temperature transmitter .. fast, sensitive response..lightweight (10) lbs..indicating scale visible 20 ft. away.. Request bulletin 456-20A.
83 *Foxboro Co.

Flowmeter, Turbine.....Supplement 1 to F&P Catalog 10C1500 tells how single basic calibration curve enables each F&P turbine flowmeter to be applied to all flow measurement conditions.
236C Fisher & Porter Co.

Measuring instrument.....Electrophoresis instrument measures the quantitative analysis of the various proteins contained within the sample tested. Includes a built-in refrigeration unit. Bul. 2287-C.
192 *American Instrument Co.

Microscope, X-Ray....."A High-Resolution PMR X-ray Microscope with Electron Microscope Conversion" describes first commercial X-ray microscope which determines chemical composition of the specimen.
236D Philips Electronics.

Photometer.....Aminco absolute light-scattering photometer measures turbidity, dissymmetry, depolarization, angular scattering. Permits study of particle sizes--micron, submicron. Bulletin 2295.
236E American Instrument Co.

Pipe, Fittings, Valves

Ducting, Polyethylene.....Thermoplastic Corrosion-Proof Ventilat- and Exhaust Systems" presents details, illustrations of all necessary components to polyethylene ducting systems.
236F American Agile Corp.

Joints, Expansion.....circular or toroidal expansion joint provides lower operating stress & is suitable for use at high temperature. Hydraulically formed-free from circumferential welds. Catalog 56.
96 *Zallea Bros.

* From advertisement, this issue

Nozzles.....lightweight, precision-built steel spray nozzles. Feed just the right amounts of fuel into combustion chamber. Get today complete spray nozzle catalog-absolutely free.
235 *Spraco Engineering Co.

Pipe, Load Capacities.....Manufacturers of Tube-Strut, universal clamp used with ordinary pipe for storage rack construction, have developed graphs showing beam and column load capacities for pipe from ½ to 2 in.
237A Tube-Strut Corp.

Piping, Pressure.....48 p. bulletin summarizes, correlates various specs of ASA Code for Pressure Piping, B31.1 and B31.1.8-1955 and ASME Boiler and Pressure Vessel Code. B&W Bulletin FB-77.
237B Babcock & Wilcox Co.

Tubing, Stainless.....consistent quality & greater uniformity plus lower costs. For full information on all 40 types of tubing request bulletin TD 120, Carpenter's new Selecting & Buying Guide.
90*Carpenter Stainless Tubing&Pipe

Tubing, Steel.....8 p. brochure describes mill grooved light weight steel tubing for use as portable pipeline with standard mechanical couplings. Tubing can be used for air, gathering, vacuum lines.
237C Republic Steel Corp.

Valve warmer.....Curved Dean thermo panel coil. It surrounds and heats and cools the valve. Bul. 355 is a treatise on Dean thermo-panel coil which takes the place of old-style pipe coils.
BL197 *Dean Products, Inc.

Valves, forged steel.....identification disc on all valves showing size, primary pressure & temperature ratings, & materials used. Complete range of sizes. Request Supplement #1 to Catalog F-9.
134 *Henry Vogt Machine Co.

Valves, plug.....stop slurry valve failure. Lubricated plug valves eliminate packing problem. Cavity free flow passages & seating surfaces which are never exposed to the line. Free Booklet V-203.
95 *Rockwell Manufacturing Co.

Valve, Sampling.....OPW-Jordan sliding gate sampling valve features self-cleaning seating construction, self-closure, no packing. Designed for drawing off fluid samples for examination. Bulletin J-90.
231D Jordan Industrial Sales Div.

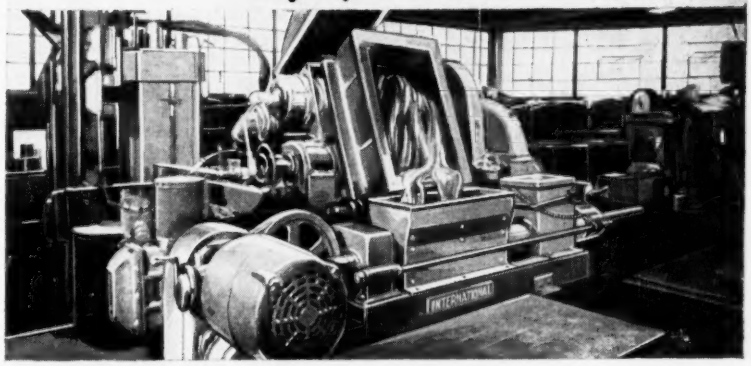
Process Equipment

Agitator Equipment.....minimum moving parts . . dust, fume & moisture-proof. Anti-friction bearings, large diameter "stepped" vertical shaft. Write today for free literature. Request Bulletin 551 & data sheet.
229 *New England Tank & Tower Co.

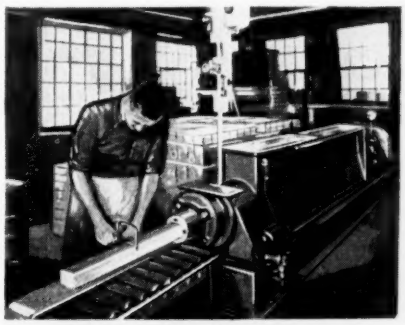
Agitators and mixers.....Heavy duty, as well acid-proof. Patented standpipe around propellor shaft assures positive agitation and circulation. Write for Bulletin No. A2-B4.
R197a *Denver Equipment Co.

* From advertisement, this issue

INTERNATIONAL
Mixing and Agglomeration Equipment



EXTRUSION MACHINES INTERNATIONAL Vac-Air Extrusion Machines are made in many sizes, from the Vac-Aire "Experimental" or Laboratory model with a 3 inch diameter auger and a capacity of 1500 to 2000 pounds in eight hours, to the Vac-Aire "Eagle" with an 18 inch diameter auger and a capacity of 20 to 30 tons per hour . . . Can be fitted with single speed or variable speed motors—jacketed for steam, oil, or water.



AGGLOMERATION EQUIPMENT

1. Reduces dusting losses and hazards by briquetting and pelletizing—as in carbon black.
2. Forms definite shapes and sizes for catalysts—powder metallurgy—pharmaceuticals.
3. Recovers waste material by nodulizing such as phosphate ores—by briquetting coke and coal fines—by briquetting fine iron and other ores for furnace charging.
4. Increases bulk density of light materials for saving in shipping and storage.
5. Prevents segregation of solid reactants—makes solids free-flowing for extrusion—provides controlled surface volume ratios.

Special Uses

The uses of Vac-Aire De-Airing Machines are legion—they extrude any material that is plastic enough to flow—such as grease sticks—buffing bar material—gypsum blocks—caulking compounds—soaps and detergents—putty—candy bars—meat—white lead—carbon sticks—fuel briquettes—iron ore—chalk—pencils—coal dust—carbide—phosphate—clay—Bentonite—various chemicals, etc. Send for Special new informative Bulletin H 1.



Any of these informative Bulletins will be gladly sent on request. Simply indicate the subjects in which you are interested.

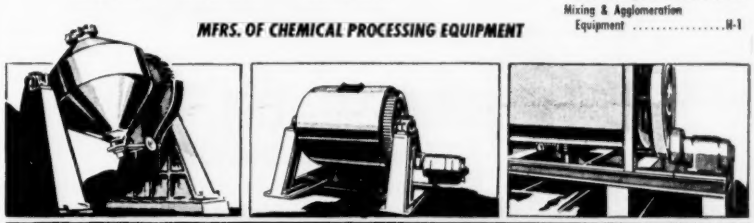
Top Entering Agitators.....73, 76, 76-A, 81
Side Entering Agitators 72-B
Portable Mixers.....74-A
Mixing & Extruding Machinery..62-A
Dry Blenders & Ribbon Mixers....78
Grinding & Mulling Pans.....74
Ball & Pebble Mills....100-A, 100-B
Laboratory & Pilot Plant Equipment.....77-A
Stock Fans & Duct Boosters....109-A
Mixing & Agglomeration Equipment H-1

INTERNATIONAL ENGINEERING, INC.

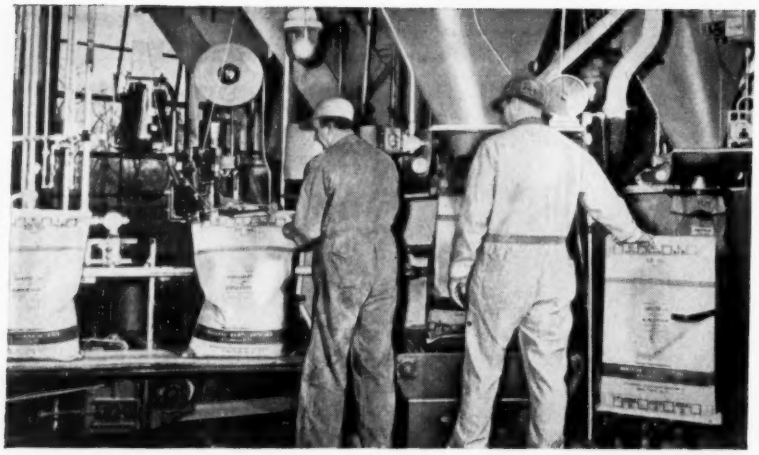
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MFRS. OF CHEMICAL PROCESSING EQUIPMENT



CONICAL DRY BLENDERS PEBBLE AND BALL MILLS RIBBON MIXERS



Richardson recommends 4 WAYS TO SAVE WASTED BAGGING DOLLARS

1. **Minimize Weight Give-Away.** Frequently, you're forced to set mean bagging weights high, to prevent falling short. With an inaccurate scale, you can lose more than $10 an hour through weight variations—especially when bagging at high speeds. Many processors have solved this problem by installing Richardson bagging scales. With average accuracy of ± 1 to 2 oz. or better, they prevent overweights and underweights, year after year.

2. **Spend Less for Bags.** You may be paying good money for nothing but "air space" in filled bags. A Richardson G-73 Impacker can end this waste. The Impacker is a simple, compact accessory that quickly "shakes down" material as it fills bags. Thus, you can pack any given quantity into smaller, neater bags. The money you save—on bag size alone—can bring you profits well beyond the cost of this equipment.

3. **Speed Up Production.** Example: the Duplex Richardson E-50 Bagging Scale can turn out twenty 100-lb. bags per minute. It's only one of many Richardson models for handling flour, sugar, rice, feed, and chemicals, in bagging ranges of 25-250 lbs.

4. **Cut Excessive Labor Costs.** Are your bagging operations overmanned? Some installations require expensive standby labor. You can cut out this cost—sometimes as much as one-third of regular labor costs—and free labor for productive work, by installing *automatic* Richardson bagging equipment. Time and labor-saving accessories include automatic feeders, sewing conveyors and pedestals, bag-holders, as well as packers like the Impacker described above. Low-cost automatic proportioning systems are Richardson specialties, too. Simple design makes maintenance easy. Any maintenance man can understand a Richardson. And, *only* Richardson maintains a nationwide service organization that can serve you *within 24 hours,* if necessary.

Richardson Scales conform to U. S. Weights and Measures H-44 for your protection.

FOR MORE INFORMATION ON RICHARDSON BAGGING SCALES, WRITE TODAY TO

Richardson

MATERIALS HANDLING BY WEIGHT SINCE 1902

RICHARDSON SCALE COMPANY • CLIFTON, NEW JERSEY

Sales and Service Branches in Principal Cities

Also manufactured in Europe to U.S. standards

1206

LITERATURE . . .

Centrifuge, Automatic.....Reineveld centrifugals . . dewatering and wash crystalline solids . . for separation of amorphous slurries . . bowl capacities from 3 to 325 gallons . . Bulletin 356.
T187 *Heyl & Patterson

Classifiers.....Bulletin 39-C contains information on construction and application of Hardinge countercurrent classifier, heavy media separator, hydro-classifier and hydroseparator.
238A Hardinge Co.

Classifiers, Air.....combined with a grinding mill is an integrated grinding, classifying & product conveying system. Also air-heating furnace for dry, ground product from undried feed. Bul. AH-467-11.
233 *Hardinge Co.

Concentration tables.....Mechanically operated, longitudinally reciprocating table consisting of a deck having a plane surface partly riffled and having a tilting device. Bul. T1-B3.
R197h *Denver Equipment Co.

Crusher, jaw.....cast steel frame, manganese jaw and cheek plates. Setting easily controlled. Large diameter shafts reduce shaft deflection. Write for Bulletin No. C12-B12.
R197d *Denver Equipment Co.

Crushers, cone.....Many types of cone crushers used in primary and secondary fine reduction crushing of ores and minerals-from asbestos to zinc. Large tonnages at low cost. Ask for Bul. 247
223b *Nordberg Mfg. Co.

Crushers, single roll.....requires only 12" working head room & only 5 horsepower. Has been used to crush heavy duty glass bottles at the rate of 1,000 a day. Bulletin #116-A for information.
44 *Sprout, Waldron & Co, Inc.

Cyclone.....Brochure 1157 is filled with tables and graphs giving performance data of all Heyl & Patterson's cyclones. Includes exploded views of cyclones, pictures of field installations.
238B Heyl & Patterson.

Digester, Continuous.....4 p. bulletin (No. 196) contains general information, design data, analysis of advantages offered by "twin" design of continuous digester; also rotary valve feeder.
238C Sprout, Waldron & Co.

Dryer-Blender.....Glassed-steel conical dryer-blender can reduce drying time as it blends. Rotation of vessel plus double cone design assures complete, constant mixing while product dries. Bulletin 956.
238D *Pfaudler Co.

Dryers.....Available in several types: direct heat, indirect heat, steam tube. Deco engineers solve your drying problem. Write for information and advice on your particular problems. Bu. D4-B2.
R197j *Denver Equipment Co.

Dryer, gas.....under high-pressure cleans & dries air, He & N. Gas input capacity of 15,000 cu. ft. Dual desicant design. Cycles controlled by program timers. For more information Catalog 407-C.
41 *American Instrument Co.

* From advertisement, this issue

Dryers, instrument air.....remove unwanted moisture from compressed air. End freeze-ups, corrosion & clogging due to water in the air lines. Write for Bulletin 223B describing instrument air dryers.
47 *Pittsburgh Lectrodryer Div.

Dryer, Vacuum.....faster, better way to vacuum-dry heat sensitive materials. Accomplished by baffling in the jacket-uniform circulation of heating medium. Pre-test services and Data Sheet #1530 free.
59 *Patterson-Kelly Co.

Drying, spray.....of heat-sensitive chemicals. Economical spray drying service & tests made under expert supervision. Fully equipped plant. Stainless steel drying equipment. Bulletin #232.
196 *Nichols Eng. & Research Corp.

Dust Collection Systems.....cyclones with exclusive Shave-off trap extra % of dust. Large-diameter design ends bridging & clogging. Ask for booklet "Collection & Recovery of Industrial Dust.
38 *Buell Engineering Co., Inc.

Dust Collector.....bulletin covers cost saving advantages of filter dust collectors. Automatic operation, flexibility of installation, high air-to-cloth ratios, minimum floor loading. Write today.
239A Entoleter Div.

Dust Collectors.....Proper water treatment will greatly reduce hard deposits, congestion, corrosion in wet-type dust collectors; promotes peak efficiency. Case histories are cited in Bulletin WDC.
239B
North American Mogul Products.

Dust Controls.....self-cleaning traveling manifold . . permits continuous suction for finely-divided dry dusts. Wet & dry dust collectors. Request brochure "Out of the Realm of Dust" immediately.
101 *Pangborn Corp.

Dust filter.....Fewer parts, lower operating costs and less maintenance. Will handle light or heavy dust laden air streams. Filters fine, course, abrasive dusts easily. Ask for Bulletin G-579.
216 *The Day Company

Engines.....Nordberg engines built in sizes to over 11,000 hp; available in two and four-cycle, in-line and "V" types . . . for Diesel, Dufuel and Spark-Ignition Gas operation. Send for Bul. 245.
223d *Nordberg Mfg. Co.

Filters.....Simplicity, accessibility, long life and efficiency are characteristics of Staynew pipe line filters for air and other gases. Bulletin 200 contains specifications, photos, diagrams.
239C Dollinger Corp.

Filters.....five bulletins offered on vertical leaf & batch, horizontal leaf & batch, & cartridge filters. Wide range of accessories . . numerous filtration innovations. Write today.
129-e *Process Filters, Inc.

Filter, disc.....Special, patented design of segments in Denver disc filters use both gravity and vacuum to give a drier filter cake. Simple, low-cost, dependable construction. Bul. No. FG-Bl.
R197f *Denver Equipment Co.

* From advertisement, this issue

PACKAGED AIR HEATERS by THERMAL

Extreme compactness, high efficiency and versatility of operation are the chief characteristics of the THERMAL Type CA direct fired air heater. Designed around the high velocity THERMAL burner, it normally requires no refractory, since combustion is limited almost entirely to the burner itself. Adding to its versatility, the CA air heater performs equally well on gas, oil or combination firing and can be adapted to all pressure levels.

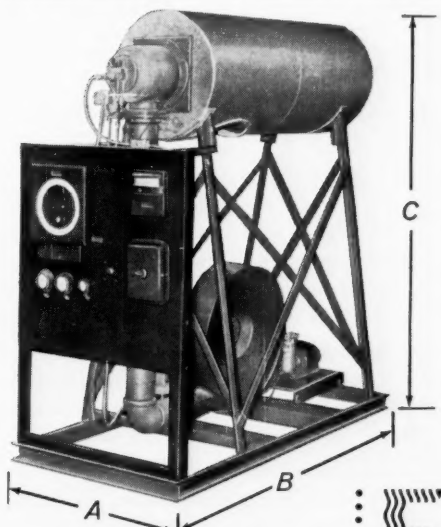
Type CA direct fired

Type CA air heaters are most frequently sold as "packaged" units complete with all necessary safety and control apparatus. These units will provide outputs ranging from 200,000 BTU/hr to better than 30,000,000 BTU/hr and at temperatures from 300F to 1500F or higher.

TYPICAL SIZES . . .

Listed below are the overall dimensions of a few of the dozens of output, temperature, and flow combinations possible in these heaters. Figures are for atmospheric pressure units. Higher pressure heaters would be smaller.

BTU/hr	AIR FLOW scfm	TEMP. IN °F	TEMP. OUT °F	A ft.	B ft.	C ft.
800,000	1,000	60	750 F	2½	4½	4
2,500,000	5,000	60	500 F	4	7	6
4,000,000	16,000	700	900 F	7	11	8
10,000,000	8,500	60	1,000 F	5½	10	8
15,000,000	10,000	60	1,200 F	6	12	8



Write for Bulletin =112

THERMAL

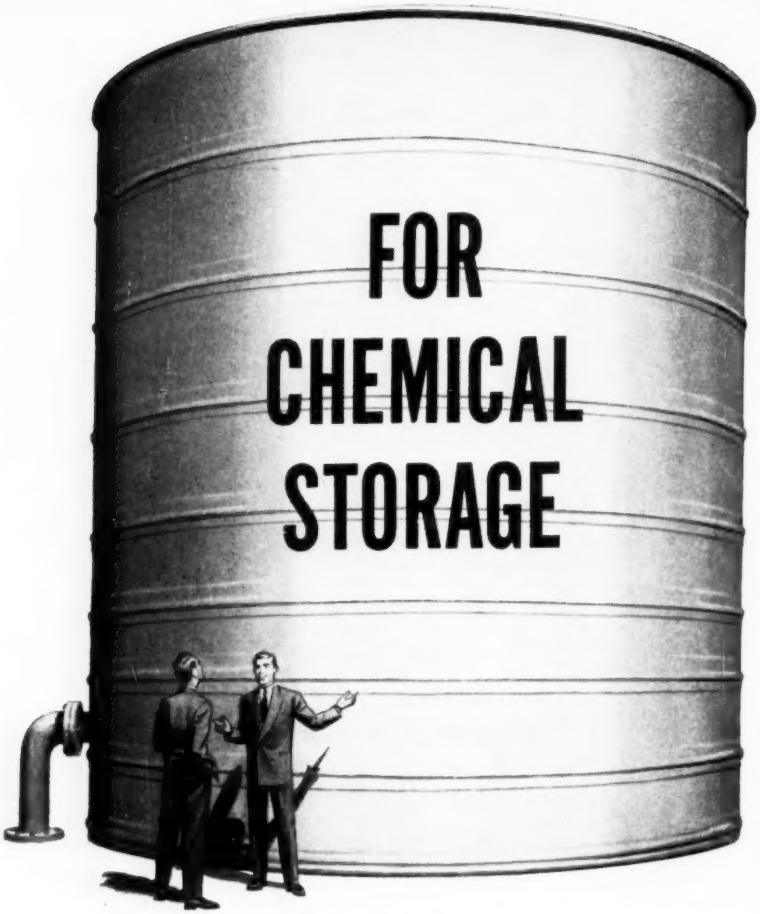
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Tanks of Beetle Bonate*
beat the corrosion bug-a-boo!

The 20,000 gallon Beetle Bonate plastic tank shown, for example, has stored spent sulphuric acid for over three years without a trace of corrosion! Lightweight, nonconductive, temperature-resistant tanks built by Beetle have proven to be tops at beating the costly chemical corrosion bug-a-boo.

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Literature fully describing Beetle and Beetle Bonate chemical storage equipment is yours free. Engineering consultation is available without obligation.

**Reg. Trade Mark*

CARL N. CORP. BEETLE PLASTICS

145 GLOBE STREET • FALL RIVER • MASSACHUSETTS

Filter, Dust.....Industrial dust control using DAY Type RJ dust filter is described in Bulletin G-579. Includes facts on new design, efficiency and operation of unit; also specs of five basic units.
240A DAY Co.

Flotation.....Flotation is the selective separation of particles from each other in a liquid pulp by means of air bubbles. Simplified continuous operation. Dependable and low-cost. Bul. F10-B81.
R197g *Denver Equipment Co.

Gamma Radiation....."Production of Gamma Radiation with a Linear Electron Accelerator" should help in planning radiation research programs and labs, in designing commercial irradiation installations.
240B Applied Radiation Corp.

Generators, inert gas.....Kemp inert gas generators with the famous industrial carburetor. Precise control of inert gas quality. Better quality control and increased safety. Write for Bul. I-10.
124 *C. M. Kemp Mfg. Co.

Grinder.....Bulletin 091 describes Micronizer grinding machine, fluid energy grinding; gives typical grinding data for various materials. Includes information on Sturtevant's fine grinding service.
240C Sturtevant Mill Co.

Laboratory equipment.....Batch and continuous test models of crushers, screens, ball mills, rod mills, agitators and mixers, classifiers, and many other types. Results can be duplicated. Bul. LG3-B10.
R197i *Denver Equipment Co.

Mill, ball.....Denver steel-head ball mill will suit your particular need. Five types of discharge trunions. All-steel construction. Low initial cost, due to quantity production. Bul. B2-B13.
R197b *Denver Equipment Co.

Mill, Impact.....new bulletin tells most efficient method of achieving particle size reduction by centrifugal force. Low h. p. requirements with high put-thru capacities. Bulletin. Write today.
208 *Entoleter Div.

Mills, grinding.....Complete line of rod, ball, tube, pebble and compartment grinding mills to meet specified conditions for wet or dry grinding in practically any process. Bul. 232.
223a *Nordberg Mfg. Co.

Mixers.....oversize bearings for maximum thrust & unbalanced loads. Shaft deflection kept at minimum. The only manufacturer to build & design whole mixer. Write today for Catalogue A-27.
32 *Philadelphia Gear Works

Mixer, batch.....produces finished product in one operation. Better wetting, dispersion & blending. Send samples for trial processing. Send for catalogue describing mixers, mills and blenders.
BL195
*Troy Engine & Machine Corp.

Mixers, centrifugal.....new principle of high speed mixing with increased put-thru. Homogeneous mix, texture improved & color intensified. Adaptable to continuous or batch system. Low h. p. need. Catalog.
240D Entoleter Div.

* From advertisement, this issue

Mixers, portable.....Especially designed for small batch processes. Precise mixing results with long term cost savings. Eastern's improved line is included in the revised portable bul. 530-B.
211 *Eastern Industries, Inc.

Mixing & Agglomeration Equipment.....Extrusion machines with single speed or variable speed motors. Agglomeration equipment reduces dusting losses. Request literature by specifying Bulletin # in ad.
237 *International Eng. Inc.

Processing Equipment.....Carrier elevator processes explosive pellets, dewaters, pries, elevates-all in one operation. Slurry dewatered from 10% solids to 97% solids in two turns. Write out coupon.
99 *Carrier Conveyor Corp.

Processing Equipment.....“test-run” products in 45-gallon lab model round processor. Four variable-speed agitators, atmospheric pressures or seal. Apply lease fee on purchase price. Bulletin G-545.
50 *Cherry-Burrell.

Pulping Equipment.....Catalog 23-SB covers full line of paper and board stock pulping equipment. Includes data on Hydrapulpers, Duopulpers, Hydrabreakers and Hydrabeaters for batch or continuous operation.
241A Black-Clawson Co.

Samplers, automatic.....Heavy duty units, extra rigid track and ball-bearing wheels assure positive travel and timing of sample cutter. Central control panel for multiple samplers. Bul. SI-B4.
R197c *Denver Equipment Co.

Screens.....complete line-stainless steel gyratory, heavy duty scalping & standard inclined screens. Dust-proof enclosures, wet or dry application. Write for screen selection guide 26C6177M.
125 *Allis-Chalmers

Screen, Vibrating.....Design and construction features of Low-Head horizontal vibrating screens, such as easy-to-remove unit mechanism, are described in 24 p. Bulletin 07B6330B.
241B Allis-Chalmers Mfg. Co.

Screens, vibrating.....Bulletin 265 describes the design and application of one of the many types of vibrating screens designed for positive screening with large capacity of accurately sized products.
223c *Nordberg Mfg. Co.

Washer, Fume.....Corrosion-free plastic fume washer with cyclone action is made from fiberglass reinforced plastic. Designed to handle acid-laden or harmful vapor and plating fumes.
241C Line-O-Coat.

Pumps, Blowers, Compressors

Air Pollution Control.....Oxy-catalyst system also recovers waste heat. Cleans up to 100% of combustable pollutants & odors. Request new brochure to end any air pollution problems.
B231 *Oxy-Catalyst Inc.

*From advertisement, this issue



Designed with the Look of Tomorrow by Raymond Loewy Associates

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MFS TEMPERATURE CONTROL

New Looks, Convenience, Efficiency for Your Process Equipment

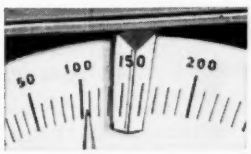
Striking as they are, good looks are only part of the story of Partlow's spectacular new control. Inside and out, the MFS is as rugged and efficient as a temperature control can be, its tough mercury-actuated element having been built to retain sensitivity and accuracy even under extreme conditions. Convenient, too! You can interchange the mercury element right out in the field... no factory adjustment is required.

The MFS comes in 10 scale ranges. Accurate within ½ of 1% of scale range, it is especially adaptable to control applications where temperature variations must be kept at a minimum; or where sudden temperature changes demand instant response.

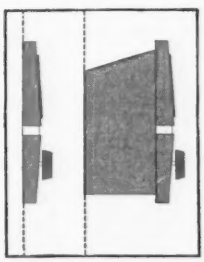
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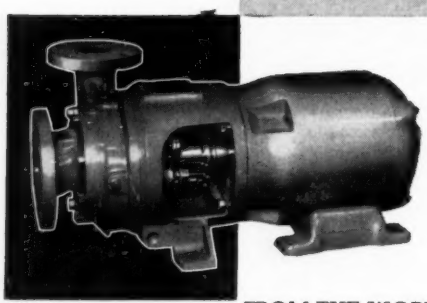


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LITERATURE . . .

Blowers, Soot.....Bulletin 1029 describes automatic soot blowing control systems. Includes description of Vulcan Selective-Sequence and Vulcan Automatic-Sequential insert-type panel controls.
242A *Copes-Vulcan Div.

Compressor.....freon or ammonia for refrigeration & air conditioning installations. Removable alloy steel cylinder sleeves, removable connecting rod bearings. Specify by no. bulletin from the ad.
234 *Vilter Manufacturing Co.

Compressors, Air.....dependable in efficient production of liquid oxygen . . heavy-duty, continuous operation at low cost . . 1700 hour check proves endurance . . write for free copy Ind. Air Bulletin M-81.
110 *Cooper-Bessemer

Lubricating System.....miniature size for limited space . . complete with pump, metering valves & controls. Adaptable to light, multiple-bearing machines . . simple installation. Send for Catalog today.
79 *Alemite

Pumps.....Designed specifically to handle materials beyond the capabilities of other pumps . . . heavy viscous materials, principally, that pumps of other configurations do not handle economically. Bul. L-54.
202 *Kinney Mfg. Co.

Pumps.....New "H" series of Nagle pumps designed exclusively for the abusive pumping jobs of industry. Three types of water ends available. Write for Bulletin "H" for information on new series.
TL195 *Nagle Pumps Inc.

Pumps.....Versatile and adaptable . . Weinman unipumps. All-purpose, general service pumps. Available in a range of ½ to 50 horsepower. Send for Bulletin 300 for complete information on unipumps.
193 *Weinman Pump Mfg. Co.

Pumps, centrifugal.....double suction pumps feature precision-made castings-efficient impellers-bronze wear rings. Complete line in capacities from 10 to 14,000 gpm. Bulletin 955-R.
100 *Buffalo Pumps Div.

Pump, diaphragm.....New features increase service life. Double-acting, positive displacement, piston pump is right for "hard-to-handle" service-corrosive, viscous, thick. Bul. 143.
222 *T. Shriver & Co., Inc.

Pump, Liquid Metals.....new motor pump designed to move liquid metal such as NaK at high temperatures. Other equipment for handling liquid Na described in U.S.I.'s booklet "Liquid Sodium".
91-C *U.S.I. Chem. Co.

Pumps, Process.....thousands of combinations from the complete Peerless line . . fits exactly with your requirements . . built to expand with future systems . . request booklet on pump design #EM-79.
112 *Peerless Pump Division

Pumping & heating units.....for preparation & combustion of all grades of fuel oil. Preheats & delivers fuel at constant pressure. Compact, space saving, available in many sizes & models. Bulletin 40.
232 *National Airoil Burner Co.

* From advertisement, this issue

Pump-Meter.....McCannameter's new design affords space savings of up to ⅔ over previous designs. Unit is meter that pumps; packless, positive displacement pump with new pumping principle.
243-A Hills-McCanna Co.

Ventillating Systems.....Corrosion-resistant polyethylene fume exhaust and ventilating components. Light weight, high impact strength, long service life. Hoods, ventilating ducts and fans. Free booklet.
BL185 *American Agile Corp.

Services, Processes, Misc.

For corrosion studies.....two special solutions which isolate surface films from metals. Iodine-methanol solution for Al alloys without Cu, & iodine-methanol sulfosalicylie acid for Al-Cu alloys. Catalog 1340.
92re *U. S. I. Chem. Co.

Demineralization.....Revised bulletin WC-111A deals with demineralization (ion exchange). Covers chemistry, operating principles of ion exchange resins plus design and construction of equipment.
243B Graver Water Cond. Co.

Fire Protection....."Fire Protection Service Plan" points out how a company can do a complete job of protecting itself against damaging fire loss. Plan stresses need for fire fighting training.
243C Ansul Chemical Co.

Floodlighting Fittings.....New floodlighting fittings for building facades, parking areas include surface-wall and thru-wall mountings. UL-approved for outdoor use. Bulletin 106.
243D Stonco Electric Products Co.

Furnaces, Laboratory.....Lightweight lab furnaces provide continuous or intermittent operating temperatures from 1,000 F. to over 3,350 F. for testing or processing small samples. Bulletin S-1055.
243E Selas Corp. of America

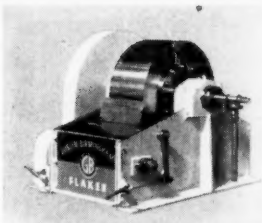
Glassware, Laboratory.....350 p., color-coded Pyrex brand laboratory glassware catalog contains more than 9,000 items, including 474 new items and 385 new custom-made products. Catalog LG-1.
243F Corning Glass Works

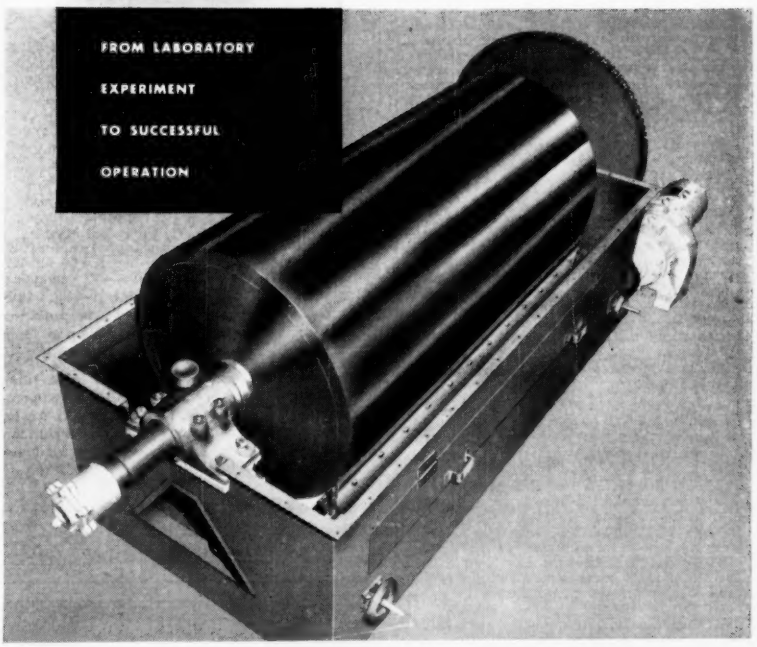
Mixing.....4 p. bulletin, "Engineering Report on Mixing," covers mixing solids with solids, solids with liquids, heating or cooling during mixing, mixing of high viscositing liquids.
243G Rietz Mfg. Co.

Models, Atomic.....ten new models for constructing organic metal chellates scaled to a magnification of 1.5 x 108. Four models represent the central atoms. Others used for rest of chelate. Catalog 1347.
92rl *U.S.I. Chem. Co.

Water Well Systems.....drilled wells provide a reliable water supply. Send for Bulletin #100 for full description of efficient, economical wells to receive the full benefit of ¾ century know-how.
39 *Layne & Bowler Inc.

* From advertisement, this issue





Your flaking problem large or small is our interest too

The commercial scale flaker, shown without the upper half of its hood in place, is fitted with a double wall drum.

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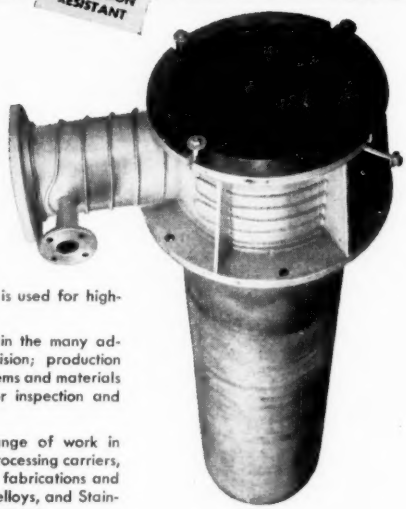
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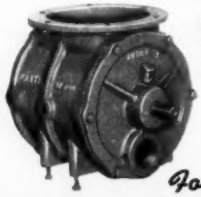
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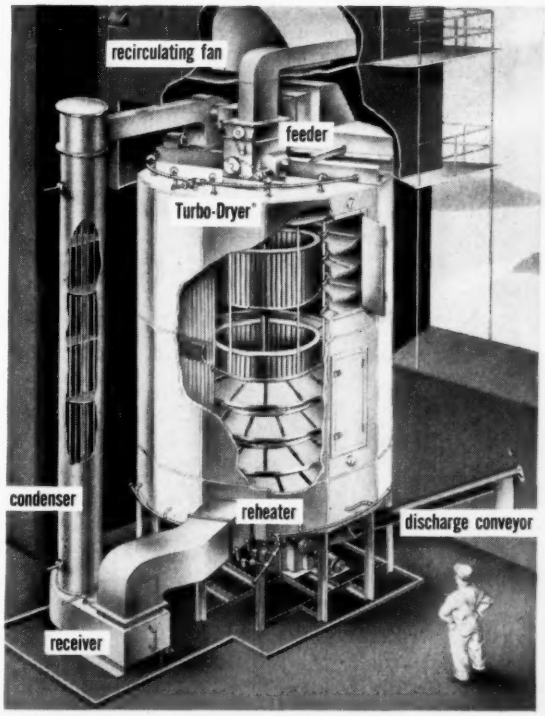
CAN IMPROVE YOUR PROCESS

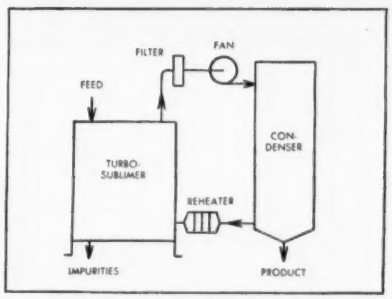
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General American Twin Drum Dryer; 42" x 10'
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International Serum Centrifuge; 10 Cup

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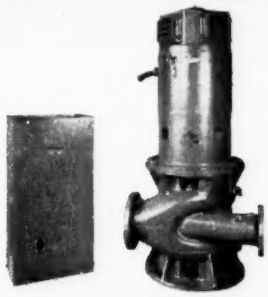
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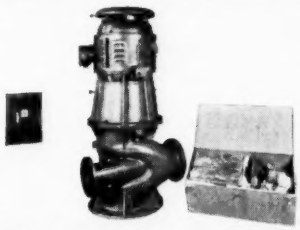
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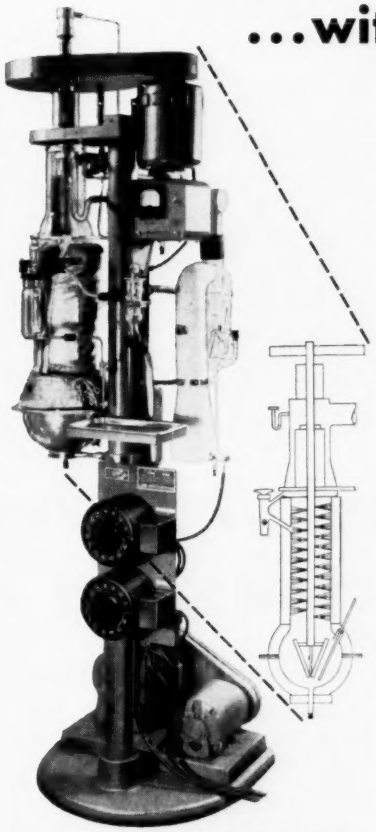
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High-vacuum **brush still** *gentle but firm, fast but thorough*

Take tall oil as an example of the CEC Brush Still's performance. The brush still recovers 95% of the fatty acids from this oil's mixture of fatty and rosin acids. The distillate is 90% pure fatty acids and is free of the characteristic, unpleasant tall oil odor. Heretofore the industry accepted 80% pure material as high grade and also accepted the odor.

Polyethylene glycol, microcrystalline wax, cedarwood oil, citral, peppermint oil, and ionone are among the other materials now being purified more efficiently in the Brush Still.

Distill up to M.W. 900 ...without refluxing



You get a royalty-free, nonexclusive license for noncommercial usage with each brush still.

Here is a *batch* still that's 900 to 1000% more efficient than the usual pot or falling film still.

With it you can separate highly pure condensates of heat-sensitive materials from M.W. 250 to 900 at temperatures up to 300° C. and higher.

Working at pressures as low as 1 to 10 microns the CEC Brush Still offers an almost ideal balance of low thermal hazard with fast distillation rates.

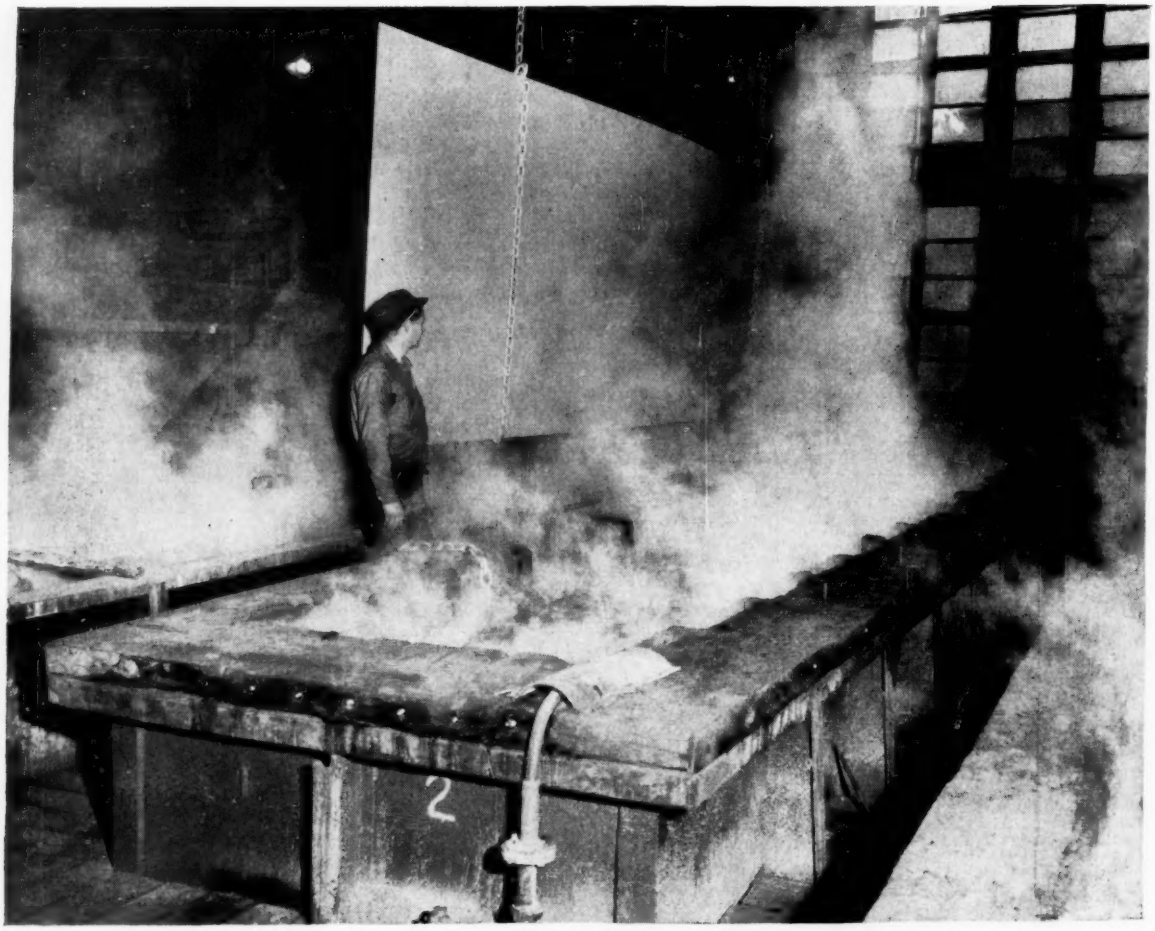
It's the *condensing brush* that makes this still unique. When you heat the distilland at the base of the heated glass column, the vapors quickly condense on the cooled brush which rotates at 450 rpm. The brush flings the condensate back to the heated surface of the column where the lightest fractions revaporize fastest.

As this process continues up the column and brush, sharply defined fractions develop, the lightest reaching the top soonest.

This is, of course, oversimplified here. At your request, we'll send complete information on the Brush Still, on CEC Centrifugal Molecular Stills, and on arrangements for custom distillation.

Consolidated Electrodynamics
Rochester Division, Rochester 3, N.Y.
SALES AND SERVICE OFFICES IN PRINCIPAL CITIES

B.F.Goodrich report:



Soaking steel for ships in steaming acid

B. F. Goodrich improvements in rubber brought extra benefits

Problem: That ton of steel plate, soon to be part of a U. S. destroyer, is about to be plunged into a steaming acid bath. This job of cleaning rust and scale off metal used to be plenty dangerous because nothing could hold the corrosive acid. All kinds of tanks were tried—wood, masonry, steel. Yet acid leaked onto the floor constantly—a waste, a hazard to workers.

What was done: A leakproof tank seemed impossible until B.F.Goodrich engineers came up with something entirely new in the way of a protective lining. They developed a combination lining of hard rubber sandwiched between soft rubber, called Triflex, that stands the hot, corrosive acid. The rubber is locked to the steel tank by the exclusive B.F.Goodrich Vulcalock process.

Savings: Acid leaks stopped wherever this B.F.Goodrich lining was used. The waste and hazard of messy, acid-wet floors became a thing of the past. At the shipbuilding company pictured here, B.F.Goodrich rubber-lined tanks have seen service since 1940, are still in use.

Why specify B. F. Goodrich: B. F. Goodrich specializes in rubber equipment to handle acids and other corrosive chemicals. When you buy B.F.Goodrich linings you buy years of engineering background with it—experience that makes sure your lining will be exactly fitted to meet all the special requirements of your work. *B.F.Goodrich Industrial Products Company, Tuscaloosa, Alabama, or Dept. M-334, Akron 18, Ohio.*

B.F.Goodrich
INDUSTRIAL PRODUCTS



METHYL ETHYL KETONE

The trend in modern automobile finishes is to acrylic lacquers for beautiful and mar-resistant finishes. Methyl Ethyl Ketone is one of the important solvents used in these new lacquers.

Acrylic lacquers for use in automotive and furniture surface coatings contribute durability, high gloss, and color retention. The high quality of Enjay Methyl Ethyl Ketone meets the exacting requirements for an acrylic lacquer solvent.

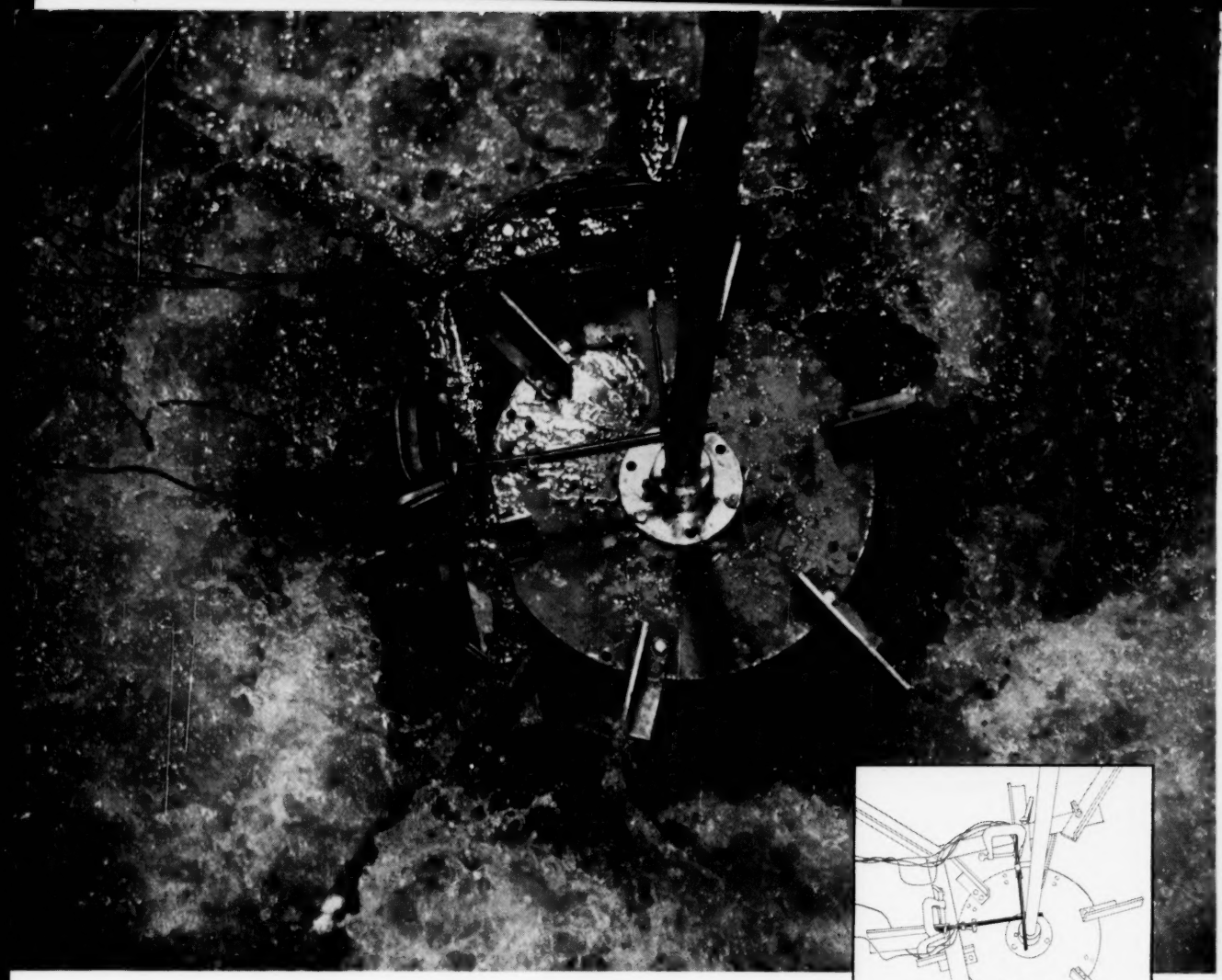
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FOR COMPLETE INFORMATION on specifications and performance characteristics of Methyl Ethyl Ketone, contact the nearest Enjay office. Shipments will be made from conveniently located distribution points in tank car, truck, or 55 gal. drum quantities.



How to make a splash **scientifically**

The road to better fluid mixing has some strange bypaths.

Here, for example, we're trying to find out what happens to a rotating mixer shaft *when the tank is empty,* or nearly empty.

Why? Plenty of people (yourself included, perhaps) can improve uniformity or yield by mixing at extremely low liquid levels while a tank is being filled or emptied.

But to do this with a long overhung shaft you need special knowledge. Random surface forces shove the impeller back and forth, deflecting the shaft and setting up unusual stresses for which the mixer must be designed.

Tracing shaft deflection

The two steel fingers (shown in photo and diagram) take the pulse of the turning, deflecting shaft. They pass data through tiny flexible-wire pickups to an electronic recorder, which makes a running trace of the shaft's deflections.

The story told by this trace enables us to design mixers that will run stably at any desired speed or shaft length and will withstand the buffeting of forces that occur during filling and drawoff.

Typical of many continuing research projects at MIXCO, this work helps fluid mixing advance from art to technology. It helps you plan for more efficient use of mechanical mixing in your processes.

If your work involves efficient mixing of fluids, we can supply time-saving data, suggestions, or calibrated research equipment. For details, see your LIGHTNIN Mixer representative now. He's listed in Chemical Engineering Catalog. Or write us direct.

Lightnin® Mixers

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